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THE DEVELOPMENT OF PERMANENT MEDICAL STANDARDS

FOR LANDING CRAFT AIR CUSTION (LCAC)

CREW PERSONNEL

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BETHESDA, MARYLAND



THE DEVELOPMENT OF PERMANENT MEDICAL STANDARDS FOR LANDING CRAFT AIR CUSHION (LCAC) CREW PERSONNEL

January 1993

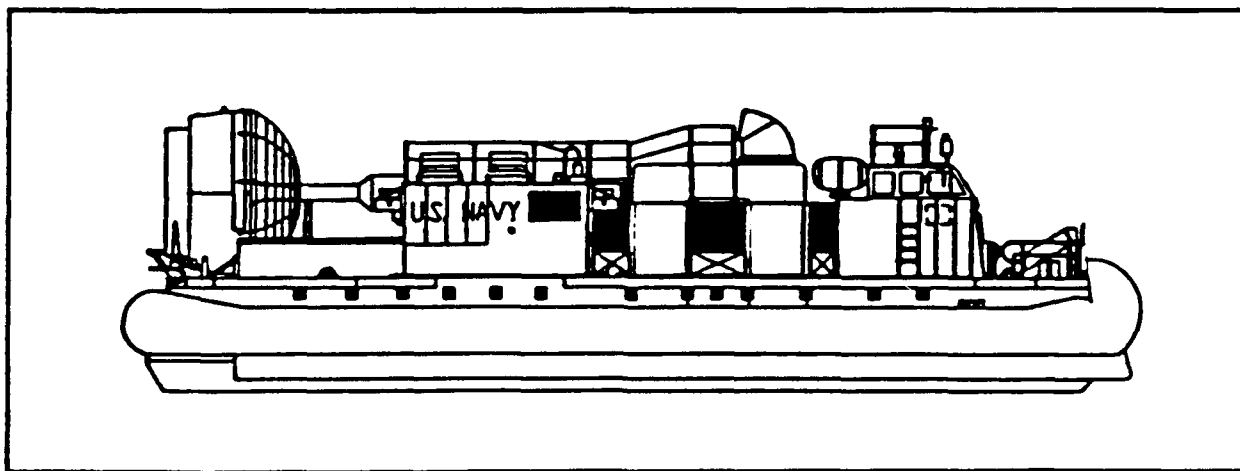
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SUMMARY

The U.S. Navy has introduced the use of air cushion vehicle technology to amphibious warfare by the development of the landing craft, air cushion (LCAC) vehicle. These new landing craft have unique operational capabilities which require specific mental and physical attributes from personnel assigned to them. The Fleet recognizes a need for certain medical qualifications in order to become and remain a part of an LCAC crew. The purpose of this work was to develop appropriate medical selection standards and revise current operational medical guidelines for these crew, along with ergonomic and medical recommendations in enhancing operational performance.

The following methods were employed to determine those standards:

- 1) Review existing interim LCAC crew medical standards.
- 2) Conduct interviews of LCAC crew, command, medical, and training personnel at two Assault Craft Units (ACU-4 and ACU-5) regarding medical issues and crew selection.
- 3) Deploy for operational orientation during actual amphibious exercises held at Camp Pendleton, CA, to provide focused observations of previously identified LCAC medical and crew selection issues.
- 4) Conduct and analyze task analysis surveys of LCAC crew personnel from both ACUs to identify and quantify specific tasks performed by LCAC crew personnel.
- 5) Conduct a crew survey at both ACUs to evaluate the relative perceived importance of medical and physical selection issues identified for permanent standards.
- 6) Incorporate input from all sources into a set of proposed permanent LCAC crew selection and medical operational standards.

Permanent medical selection standards were identified and are now part of the **"Manual of the Medical Department"** (NAVMED P-117). Suggested revisions to current operational medical standards were identified and forwarded to the Naval Sea Systems Command. These revisions are now included in the **"Safe Engineering and Operations Manual (SEAOPS) for Training Standardization and Evaluation of Crewmember Qualification, Landing Craft Air Cushion (LCAC)."**

From our research, we have generated a list of recommendations that should be considered in any future changes to the LCAC medical standards, to LCAC crew training/operational procedures, or to LCAC design. A summary of these recommendations is provided below.

Recommendations

1. Provide a means for urinary relief while underway.
2. Provide a source of liquids in starboard cabin.
3. Provide emergency rations on board craft.
4. Redesign seats in starboard cabin.
5. Ensure that support ships give appropriate attention to LCAC crews' need of a regular food supply.
6. Training and operational procedures should focus on the successful performance of the following: a) depth perception during night vision, b) problem solving, c) teamwork, d) reaction time, e) visual-spatial orientation ability, f) assertiveness, and g) oral expression and comprehension (i.e., communication skills).

INTRODUCTION

In 1966, three Patrol Air Cushion Vehicles (PACV) were introduced into the Vietnam War to patrol Vietnamese waters for the U.S. Navy during Operation Market Time (Cutler, 1988). These craft designed by Bell Aerosystems were similar to British commercial hovercraft at a cost of \$90K each. They were capable of skimming the water with their one foot hull-borne draft at speeds of 70 knots clearing the water by four feet when airborne. A 1,900-hp gas-turbine system drove an air screw for propulsion and a lift fan for airborne operations. The PACV crew consisted of an officer and three enlisted and crafts were armed with grenade launchers and machine guns. The PACVs proved to be more threatening in appearance (referred to as "dragon boats" by Vietnamese fisherman) than effective since they were unable to patrol at their phenomenal speeds; their high noise level and limited visibility hampered their effectiveness in surveillance; and their range and endurance even in two-foot seas were considerably less than those of conventional patrol craft. PACVs made 24 patrols during Market Time and participated in other aspects of the naval war after the Market Time evaluation.

In 26 years, the technology and the operational mission behind the PACVs evolved. Air cushion vehicles were redesigned to haul equipment and personnel, and their mission changed to supporting amphibious assaults. The current hovercrafts became a part of the fleet in 1983 (Klein, 1989), as Landing Craft Air Cushion (LCAC) vehicles. LCACs are built by two manufacturers, Textron Marine Systems and Avondale Gulfport Marine at a cost of \$23M per LCAC (Schlichting, 1991). The current LCAC design is a 70-ton, gas turbine-powered craft, capable of 40-plus knots over water or 25 knots over land, carrying 60 tons of cargo up to 50 miles, and able to negotiate 80% of the world's beaches (versus 17% accessible to conventional landing craft; McKearney, 1987). Control, engineering, and navigational systems are much more sophisticated than the earlier PACVs. The crew now consists of five members, all of whom are enlisted. LCACs engage in over-the-horizon (OTH) rapid beach support as part of a combined air/sea assault. They were used recently in Operation Desert Storm and in humanitarian assistance to the country of Bangladesh in Operation Sea Angel.

In the 26 years since hovercrafts were first introduced into the Navy, both physical and mental demands have changed sufficiently to require a new set of medical selection standards, and a revision of the current operational medical standards.

Furthermore, ergonomic (i.e., human factors) modifications to the present hovercraft design need to be considered in order to maintain the LCAC crew at their optimal level of performance. These issues are discussed in this report.

This report is divided into two parts. Part I contains four sections: Section (1) outlines the medical selection and operational medical criteria; Section (2) describes informal interviews of LCAC personnel; Section (3) describes research observations during an operational training mission; and Section (4) describes the findings from a medical survey conducted with LCAC personnel. Part 2 describes the task analyses performed and the top 10 critical duties of each LCAC crew position. Each of the factors noted in this report were considered and either included in the permanent medical standards or are provided here as recommendations for any modifications needed in the future. Figure 1 outlines the sequence of events leading up to the permanent LCAC medical selection standards and suggested revisions to the operational medical standards.

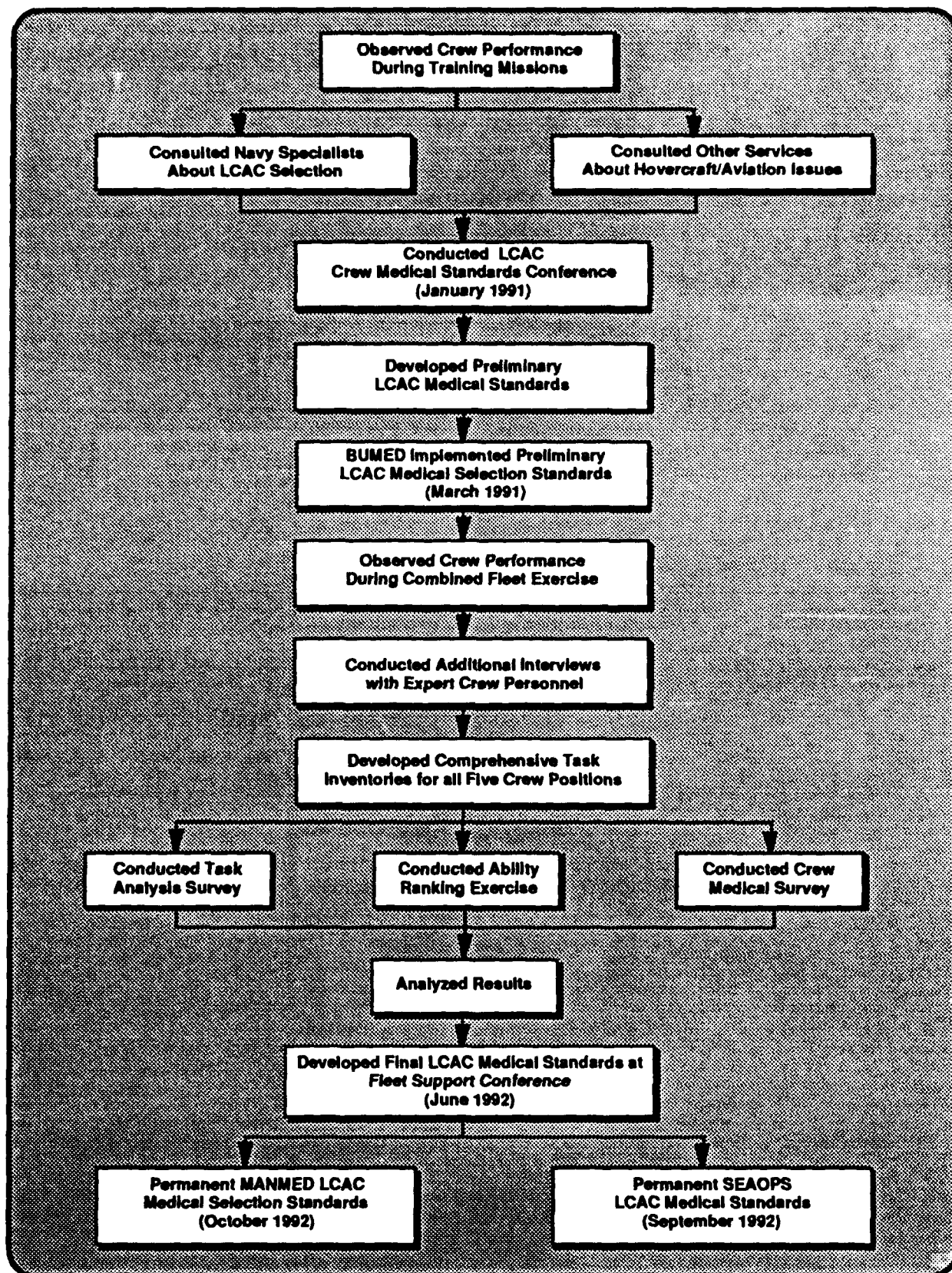


Figure 1. Sequence of events leading to development of the LCAC medical standards.

PART I. LCAC CREW BIOMEDICAL AND OPERATIONAL ISSUES

SECTION 1. LCAC MEDICAL SELECTION AND OPERATIONAL MEDICAL STANDARDS

DESCRIPTION OF LCAC CREW

The current LCAC crew consists of five personnel with separate responsibilities. Three crew members (Craftmaster, Engineer, & Navigator) located in the starboard cabin operate the craft and two crew members (Loadmaster & Deck Mechanic) in the portside cabin are responsible for any equipment, supplies, or troops that are aboard the craft. The starboard crew each have approximately 150 responsibilities and the portside crew each have nearly 120 responsibilities to do while on a mission (see Part 2). Each crew position requires a different level of experience and expertise with the chief operator, the craftmaster, requiring the greatest amount of experience. Below describes the type of personnel and their military rating required in each crew position:

Starboard Cabin

1. **Craftmaster** is the primary craft operator with overall responsibility for the craft. Ratings: a) Boatswain's Mate; b) Quartermaster; c) Gas Turbine Maintenance Specialist; d) Operations Specialist.
2. **Engineer** maintains propulsion and operating systems during underway and maintenance periods. He is also trained as a back-up craft operator. Ratings: Gas Turbine Maintenance Specialist.
3. **Navigator** assures correct craft position and coordinates communications. Ratings: a) Quartermaster; and b) Operations Specialist.

Portside Cabin

1. **Loadmaster** ensures proper loading and unloading of craft and safety of embarked personnel underway. Rating: Boatswain's Mate.
2. **Deck Mechanic** assists Loadmaster in performing maintenance and repairs under the direction of the Engineer. Ratings: a) Gas Turbine Maintenance Specialist; and b) Gas Turbine Electrician Specialist

Thus, an LCAC crew should consist of experienced, competent personnel who are in good physical condition and are able to perform well for a prolonged period during amphibious warfare missions.

HISTORY OF MEDICAL STANDARDS

Initially, Naval Sea Systems Command (NAVSEA) provided medical and selection requirements for LCAC crew personnel in the **"Safe Engineering and Operations Manual (SEAOPS) for Training Standardization and Evaluation of Crewmember Qualification, Landing Craft Air Cushion (LCAC)."** The medical requirements in this manual were minimal, but with a strong emphasis on vision, hearing and articulation. These standards were, in fact, similar to those required by the British Commercial Aviation Administration for hovercraft operators and those developed by the U.S. Army for Air Cushion Vehicle (ACV) operators (U.S. Army Regulation 56-9), but were less selective than those of the Canadian Coast Guard (Medical Examination of Seafarers) for hovercraft operators.

Physical examinations of the first groups of LCAC operator and nonoperator candidates were not uniform, with some individuals receiving the equivalent of aviator physicals, while others had only a cursory review of their medical records and minimum physical examinations. Due to the lack of standard medical and psychomotor screening, a relatively high attrition rate (35-41%; Dolgin, personal communication) occurred in the first groups of LCAC operator candidates in completing their 21-week training period.

Factors that led to the need for developing permanent LCAC medical selection standards included: 1) a constricted personnel pipeline (e.g., Craftmaster candidate- E7 or above, Boatswain's Mates, Quartermaster, or Gas Turbine Maintenance Specialists) and lack of ready replacements; 2) the high cost of training (approx. \$500K per operator trainee); 3) a training fatality with medical implications; and 4) the evolving realization of LCAC uniqueness and special physical requirements needed for its successful operation.

Attrition from the 21-week, Phase I, training program came under control when the Naval Aerospace Medical Institute (NAMI) in Pensacola, FL became officially, in June 1990, the interim medical examination facility for LCAC operator candidates. NAMI provided a consistency in medical personnel and physical screening that was lacking before. NAMI's physicians identified disqualifying conditions (primarily visual ones) not noted in pre-examinations performed on candidates at branch and Fleet medical clinics prior to arrival at NAMI. In addition, Naval Aerospace Medical Research Laboratory (NAMRL) in Pensacola began testing LCAC Craftmaster and Engineer

candidates with a computerized psychomotor screening test that evaluated their ability to hear, see and manipulate hand and feet controls simultaneously -- all components necessary to operate an LCAC.

As the medical screening requirements continued to evolve, so did the need to identify a permanent set of medical selection standards. NAVSEA tasked the Naval Health Research Center (NAVHLTHRSCHCEN) in San Diego to coordinate these efforts and to organize a conference to develop interim medical selection standards with the goal of finalizing these into permanent standards before the end of FY 92.

In January 1991, NAVHLTHRSCHCEN hosted a conference to outline a set of interim medical selection standards and discuss changes in operational medical standards (Proceedings, LCAC Interim Medical Standards Conference, 1991). NAVSEA, ACU, Bureau of Personnel (BUPERS), and NAMI medical and scientific specialists familiar with LCAC attended this conference. The interim standards were intended for use until permanent standards could be developed and approved by the operational and medical community. Two classes of LCAC personnel with differing requirements were identified during that conference; Class I, including Craftmaster and Engineer, and Class II, including Navigator, Loadmaster, and Deck Mechanic. A list of allowable medications and suggested periodic physical examinations were also developed at that time. It was understood that relevant and appropriately selective permanent medical standards and medical operational guidelines would be developed based upon research efforts and Fleet experience with these interim medical standards. The interim medical selection standards were put into effect (BUMED ltr 5050 ser:22/223 of 12 March 1991).

In June 1992, many of the medical, operational, system management, and personnel specialists who met at the earlier conference met again at the LCAC Fleet Support Conference at Camp Pendleton, CA to finalize the medical selection and operational medical guidelines. It was agreed at that meeting that only Class I candidates would undergo thorough medical examinations at NAMI. It was also decided that medical records would be screened by local medical authority for Class II candidates to determine the current physical examination on record, and if found that a new examination was needed, local medical authority would provide it. By August 1992, the proposed permanent MANMED LCAC crew medical selection standards and the proposed SEAOPS revisions to operational medical standards were submitted to the Bureau of Medicine and Surgery (MED-22). The MANMED standards were approved

for publication and the revisions to the SEAOPS manual were forwarded to NAVSEA. These were discussed at a SEAOPS LCAC conference in September 1992, and were approved for publication by members of that conference.

NAMI is now the permanent medical and psychomotor screening facility for all potential LCAC craftmasters and engineers. Table 1 indicates that from May 1990, to January 1993, 95% of the LCAC candidates who underwent medical and psychomotor screening completed the 21-week, Phase I, training. Table 2 indicates that of the 95% candidates who passed, most craftmaster candidates (94%) and all engineer candidates (100%) successfully completed the Phase I training.

TABLE 1
LCAC CREW TRAINING OUTCOMES
BASED ON PSYCHOMOTOR (PMT) SELECTION

ALL CANDIDATES (Craftmasters and Engineers)		
	With PMT Selection¹	Without PMT Selection ²
Overall N	148	85
Recommended for training by NAMI/NAMRL	98 (66%)	N.A.
Not Recommended	50 (34%)	N.A.
Phase I Training N³	63	85
PASS	60 (95%)	68 (80%)
FAIL⁴	3 (5%)	17 (20%)
¹ May 1990 - January 1993		
² 1989 - 1990		
³ Not all recommended subjects have entered or completed Phase I training		
⁴ Attrition rates prior to 1989 ranged from 35-41%		

(Courtesy of LCDR Dan Dolgin, MSC, USN)

Table 1 also indicates that those candidates who were medically screened and did not receive the psychomotor screening, only 80% of those candidates went on to pass the Phase I training. Furthermore, of those candidates who were not screened for their psychomotor coordination abilities, only 67% of the craftmaster candidates and 88% of the engineer candidates eventually passed the Phase I training. Clearly, the psychomotor screening is an important element that adds to the overall success of the LCAC training program.

TABLE 2
LCAC CREW TRAINING OUTCOMES BASED ON
PSYCHOMOTOR (PMT) SELECTION ORGANIZED BY TYPE OF CANDIDATE

CRAFTMASTER CANDIDATES		
	With PMT Selection¹	Without PMT Selection ²
Overall N	114	33
Recommended for training by NAMI/NAMRL	76 (67%)	N.A.
Not Recommended	38 (33%)	N.A.
Phase I Training N³	51	33
PASS	41 (94%)	22 (67%)
FAIL⁴	3 (6%)	11 (33%)
ENGINEERING CANDIDATES		
	With PMT Selection¹	Without PMT Selection ²
Overall N	34	52
Recommended for training by NAMI/NAMRL	23 (68%)	N.A.
Not Recommended	11 (32%)	N.A.
Phase I Training N³	12	52
PASS	12 (100%)	46 (88%)
FAIL⁴	0	6 (12%)
¹ May 1990 - January 1993 ² 1989 - 1990 ³ Not all recommended subjects have entered or completed Phase I training ⁴ Attrition rates prior to 1989 ranged from 35-41%		

(Courtesy of LCDR Dan Dolgin, MSC, USN)

SECTION 2. INTERVIEWS OF LCAC PERSONNEL

INTRODUCTION

Informal preliminary interviews of LCAC crew personnel, and command, medical, and training staff at both East and West coast ACU's were conducted by NAVHLTHRSCHCEN researchers. This was done as an initial step in identifying major areas of concern regarding candidate selection and medical and operational issues perceived by these personnel during their experience with the LCAC program. The issues identified during these interviews were further evaluated in crew surveys as well as through consultation with other experts. Most of the issues identified during these interviews were later validated as legitimate concerns during the later steps of this work.

METHODS

Informal interviews were conducted with a total of fifteen LCAC unit personnel including crew members, and command, medical, and training personnel from both the East and West coast ACU's. All members were active duty U.S. Navy members assigned to one of the ACU's. It was acknowledged that their comments would be kept anonymous. Open-ended discussions were conducted. Areas of personnel interest/concern included:

1. Medical selection standards including vision, communication-related abilities, gastrointestinal conditions, musculoskeletal conditions, and psychological stability
2. Operational issues
3. Craft engineering/systems and equipment
4. Environmental concerns

The issues and concerns identified during these interviews were included for consideration in the later phases of this work, including the medical issues survey (Section 4).

RESULTS

Physical Selection Criteria

Vision

Vision-related performance criteria dominated the list of physical standard concerns for the LCAC candidates, and included the following visual items:

1. **Night vision.** This was identified as an important physical factor for candidates and trained crew personnel. The prevalence of night missions was emphasized, as well as the heavy reliance on visual cues for navigation and beach positioning during operations. Inconsistency in use of night vision goggles (NVG) during night operations was also mentioned. At the time these interviews took place, *standardized training in the use of NVG was not available to these crews.*
2. **Color vision.** Color vision was identified as critical primarily for identifying navigation lights and beach markers during operations. There was agreement that color vision was essential for all crew personnel.
3. **Depth perception.** This capability was considered important to all craft operators (Craftmasters and Engineers). The comment was made that depth perception seemed to be lost whenever using NVG. There was general consensus among operators that depth perception was most critical during well deck approaches.
4. **Distant visual acuity.** The required minimum for distant visual acuity was a topic of interest primarily to craft operators. There was a wide range of opinion regarding the necessity for excellent uncorrected vision by crew members in these interviews. All operators and the majority of other crew members concurred regarding the necessity of vision correctable to 20/20 for craft operators and Navigators.
5. **Near vision.** This was not a topic of great concern to participants. It was not a spontaneously mentioned item. Most crew members with whom this was discussed did not feel strongly that excellent near vision should be required, or that defective near vision would seriously degrade mission performance.
6. **Peripheral vision.** There was a moderate amount of interest in this issue during these preliminary interviews. No single reason was stated as the determinant for this. One comment made by operators and navigators was that use of NVG eliminated peripheral vision and that this was a real concern during craft operation.

Hearing and Speech

There was consensus among interviewed personnel that unimpaired hearing is essential for all crew positions. The need for close communications to support teamwork underway was felt to be critical to mission performance. Similar statements were made about the necessity for clear and unimpaired speech.

Gastrointestinal System

Some comments were made regarding the negative effects upon performance by any gastrointestinal problem, including gastritis, ulcers, or colitis. Factors stated to support these opinions included the relative high stress of these duty assignments, the need for full crewmember capability during underway operations, and the likelihood that any of these disorders would worsen under operational conditions.

Musculoskeletal System

Lower back disorders (including herniated intervertebral discs) and chronic joint problems were identified as detrimental to performance of LCAC duty. It was recommended by most participants that any candidate with low back problems be disqualified from LCAC training or assignment.

Motion Sickness

There were varying opinions among participants as to the relative prevalence and severity of motion sickness among LCAC crew personnel. There was general agreement that LCAC craft motion in higher sea states was unique and unlike that of conventional craft, and that craft attitude changes and acceleration/deceleration forces in these sea states could be rather severe. The majority did feel that medication for motion sickness should be approved for crew use, provided that it would not degrade performance.

Psychological Status

Duty as an LCAC crew member was universally described as stressful and requiring personnel with "above average" stress management skills. Reasons cited for this included long work hours and multiple crew member tasking at both ACU's, with increased responsibility for expensive and maintenance-intensive systems. Methods were suggested for augmenting stress management, including a command-wide physical conditioning/maintenance or aerobics program for all crew personnel.

Operational Issues

As previously stated, all crew personnel (particularly engineers and deck mechanics) were of the opinion that the complex and intensive maintenance schedule required by these craft, helps to create increased psychological demands for all crew personnel. It was reported that up to 50% of crew time per week is spent in routine maintenance. The comment was made that these long maintenance hours curtail other necessary activities, including physical training.

Long work cycles were mentioned for both non-deployed and deployed duty. The term "brain dead" was used independently by a number of personnel, describing the inattentiveness resulting from the fatigue of long continuous operational periods. Despite this work schedule, LCAC crews actually look forward to deployment time, since maintenance demands are less and operational time is increased in this setting. It was reported that in the deployed setting, at least one hour of pre-flight and approximately two to three hours of shut-down procedures are necessary for each day of mission performance.

Craft Engineering/Systems and Equipment

Seating. Complaints, primarily from operators, were registered concerning the discomfort of current craft starboard seating when encountering heavy seas. These complaints were related to transmitted shock of impact, with seating becoming increasingly more uncomfortable under these conditions.

Noise. Moderate communications difficulty (between crew members and with other craft) with turbines operating was reported. Noise was not of subjective importance to most personnel, although a minority of starboard crew personnel noted additive effects of noise on fatigue.

Vibration. The additive effects of vibration and fatigue were mentioned by several personnel.

Control System. Several craftmasters commented on the frequent malfunction of a trim control wheel on the control column requiring one hand to continually exert pressure on it to maintain craft attitude, and causing fatigue and muscle cramps.

Environmental Concerns

The most significant factor mentioned related to the environment was that of vision degradation, primarily in night operations. There was a wide divergence of opinion regarding aided night vision and the use of NVG in this environment.

Craft behavior in higher sea states and the effects of this on crew performance have been noted previously.

DISCUSSION

The overall impression gained as a result of these interviews was that LCAC crew personnel operate in a moderately to highly stressful environment operating complex and expensive equipment, and are called upon frequently to make prompt and consistently accurate decisions. The parallel previously drawn between their operating environment and demands and that of aviation personnel is obvious, but differences in task structure were also made more clear. One of the more striking differences noted was the greater responsibility LCAC crew personnel have for the maintenance of their craft than do aviation personnel/aircrew. This constant increased responsibility coupled with long operating hours and a high-tempo mission schedule heightens the need for teamwork and communication among crew members, and emphasizes the requirement for exceptionally fit crew candidates who can tolerate increased personal and physical demands.

Items of interest and concern regarding specific physical requirements for LCAC crew, operational medical and health issues, and craft design and equipment were identified in these interviews and included in subsequent phases of this work. These issues reflected many of those stated previously by LCAC personnel, command staff, and systems experts.

SECTION 3. OBSERVATIONS DURING AN OPERATIONAL TRAINING MISSION

INTRODUCTION

In order to understand the operating environment of the LCAC crew, NAVHLTHRSCHCEN investigators accompanied three LCAC crews from Assault Craft Unit 5 (ACU-5) on a combined fleet amphibious landing exercise conducted off Camp Pendleton, California from 19-21 November, 1991. Prior to deployment, the investigators had identified several areas of interest during interviews with crew members at ACU-5 (Camp Pendleton, CA) and ACU-4 (Norfolk, VA), and from input from LCAC programs and systems managers. These areas included:

1. Operational Factors (crew day and operational schedule)
2. Physiological Factors (nutrition, hydration, sleep, and motion sickness)
3. Equipment Factors (cockpit lighting, night vision goggles (NVGs), safety equipment)

Study Conditions

All thirty-one observed LCAC crew members were active-duty, male U.S. Navy personnel with no known medical problems. The weather throughout this exercise was temperate, with daytime temperatures in the 60 degree (Fahrenheit) range. Sea conditions were generally favorable, reaching a maximum sea state of approximately 2 on the evening of day 2, and a sea state of 0 to 1 thereafter. Visibility was unrestricted, with a quarter moon at night, and consistent fair weather.

Over the 4-day period, the LCAC crews worked a total of 50 hours with the third day's early morning exercises canceled for reasons of crew fatigue. Day one consisted of loading and offloading of USMC equipment (HUMMV, Artillery, etc.) and personnel throughout the day. Day two consisted of two PM sorties, with one daylight and one nighttime pick-up and well deck transfer of USMC equipment and personnel between the beach and an amphibious support ship. Day three consisted of a coordinated daylight amphibious assault conducted with other USN/USMC operational units. This sortie consisted of a single, brief run to the surf zone and turn-away. Day four consisted of a pre-dawn (night) beach assault, similar to that of the previous evening.

During this exercise, in addition to the researcher's operational observations, crew members completed 24-hour sleep logs for day two, and kept records of dietary intake during two 24-hour periods (Days 2 and 3). The results of these observations are detailed in the following sections.

Operational Factors

Crew Day

Crew day began at approximately 0630 on day 1, 0600 on day 2, 1100 on day 3 (Morning exercise canceled by the Officer-in-charge (OIC) due to crew fatigue), and 0330 on day 4. The average working day was 16 hours and was the longest for the engineers, deck mechanics, and loadmasters due to their involvement in shut-down and wash-down procedures.

Operational Schedule

LCAC sorties were scheduled throughout the combined operations of this exercise. The LCACs were usually the first units to make beach landings with high priority loads, and were involved in all the nighttime beach assaults involving Marine units during this period of observation. During days 1 and 2, multiple sorties were made to and from the beach continuously over periods as long as seventeen hours, transferring personnel and equipment. On day 3, a single high-speed run and turn-away at the surf line was made, and repeated on the following morning.

Physiological Factors

Nutrition

Design and Procedure. Thirteen LCAC crew members recorded food consumption over a 2-day period during the 4-day operational training mission. Diet record cards were distributed to them along with verbal instructions in how to complete the cards. The record cards were sized to fit into shirt pockets to encourage recording at meal time. The information requested included the location of meal, food items consumed, and portion size. A ruler is drawn on the diet card to aid subjects in accurately reporting portion sizes (see Figure 2). The cards were distributed on the afternoon of 19 November 1991 to be completed through the 24 hour period of 20 November. The diet records were analyzed by a nutritionist using a computerized software program, "Nutritionist III Version 4.0" (N-Squared Computing, Salem, OR). This

software is composed of approximately 2,000 food items with the United States Department of Agriculture being the primary source of data. When specific food items were not found in the database, comparable substitutions were made. Because the record cards were not distributed until the afternoon of the first day, the estimated food intake represents less than two complete days. For this reason, the total food consumption was averaged by 1.8 rather than 2.0 for calculating daily average intakes.

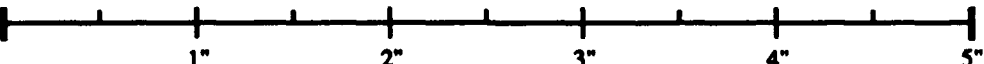
LAST NAME _____		FIRST NAME _____	DATE _____	SUBJECT NUMBER _____
PLACE/MEAL	FOOD AND/OR BEVERAGE ITEM (INCLUDE WATER) * ***		PORTION SIZE**	
<p>* Record brand names, fresh, frozen, canned, etc. ** Use abbreviations such as oz, tsp, TB, CP, g. *** List ingredients on back as needed</p> 				

Figure 2. Diet record card used for recording food intake.

Results. Caloric intake, grams of protein, grams of carbohydrate, and grams of fat consumed daily are presented in Table 3. Caloric intake ranged from 359.0 to 3236 kilocalories per day. The mean caloric intake was well below the lower range recommended by the military (2800-3600 kcal) for healthy, moderately active men (Nutrition allowances, 1985). Protein intake ranged from 22.5 to 142.0 grams, carbohydrate from 47.2 to 360.0 grams, and fat from 22.8 to 150.0 grams. Compared to the U.S. Dietary Guidelines for Americans (Nutrition Committee, American Heart Association, 1986), the mean protein intake exceeded the 12% of total kcal recommended; mean carbohydrate intake was below the 58% recommended; mean intake of fat exceeded the recommended 30%.

TABLE 3
MEAN DAILY NUTRIENT INTAKE BY LCAC CREW

		Protein (% kcal)	Carbohydrates (% kcal)	Fat (% kcal)
Recommended Intake		(12%)	(58%)	(30%)
Mean (Kcal)	1782	96.1g (21.6%)	178.7g (40.1%)	86.9g (43.9%)
± SD	± 745	± 39.8	± 96.2	± 31.5

Tables 4 and 5 present the average daily intakes of selected nutrients. Nutrients should be considered deficient when intake is below 75% of the military recommended dietary allowance (MRDA), and excess when above 125% of the MRDA. Nutrients deficient in the diets of LCAC operators included vitamin C, B6, folacin, magnesium, and zinc. In excess were vitamin A, riboflavin, niacin, B12, and phosphorus.

TABLE 4
MEAN DAILY INTAKE OF SELECTED VITAMINS BY LCAC CREW

	Daily Intake	± SD	% MRDA
Recommended intake	-	-	75-125
Vitamin A (mcg RE)	1365	± 2662	137
Vitamin D (mcg)	5.5	± 5.4	110
Vitamin E (Mg)	11	± 9.6	110
Vitamin C (Mg)	38	± 31	63
Thiamin (Mg)	1.5	± 0.7	94
Riboflavin (Mg)	2.4	± 1.5	126
Niacin (Mg)	35	± 22	167
B6 (Mg)	1.6	± 1.0	73
Folacin (Ug)	112	± 48	28
B12 (Ug)	5.2	± 3.0	173

Water intake by subjects was also determined (Table 6). The fluid intake requirement for adults is approximately 35 ml/kg usual body weight (Mahan and Arlin, 1992). Using this requirement and an estimated reference weights of 72 to 79 kg body weight (National Research Council, 1989), water consumption should have ranged from 2520 to 2765 ml per day. The subjects' water intake was considerably lower than this.

TABLE 5
MEAN DAILY INTAKE OF SELECTED
MINERALS AND ELECTROLYTES BY LCAC CREW

	Daily Intake	± SD	% MRDA
Recommended intake	-	-	75-125
Sodium(Mg) ^a	2265	± 960	67-206
Potassium (Mg) ^b	2223	± 1151	40-119
Calcium (Mg)	957	± 697	120
Phosphorus (Mg)	1267	± 674	158
Magnesium (Mg)	204	± 100	58
Iron (Mg)	14	± 5.9	140
Zinc (Mg)	11	± 5.0	75

^a Presented as percents of the range of safe and adequate intake of sodium (1100-3300 mg) published in the Recommended Dietary Allowances (National Research Council, 1989).

^b Values reflect percents of a range of recommended intake over an extended period of time.

TABLE 6
WATER INTAKE BY LCAC CREW (TOTAL AND BEVERAGE WATER)

	Total Water (ml) ^a	Beverage Water (ml) ^b
Recommended intake ^c	2643	--
Mean	1258	875
± SD	± 622	± 527

^a Total water values include water from both food and beverages.

^b Beverage water values include water only from beverages (i.e. coffee, soda, drinking water).

^c Recommended intake of water is based on an estimated average body weight of approximately 76 kg.

The average caffeine intake for the 13 subjects is shown in Table 7. However, four subjects consumed no caffeine, and two subjects consumed foods with marginal caffeine content (i.e. chocolate milk and chocolate icing). The remaining seven subjects consumed foods high in caffeine (coffee and caffeinated sodas); their caffeine intake was notably higher. One subject consumed an average of 1011 mg of caffeine per day, the equivalent of approximately ten cups of brewed coffee. Caffeine intake greater than 200 mg has been associated with negative physical effects. This data indicates consumption of large quantities of caffeine by an appreciable fraction of LCAC operators.

TABLE 7
CAFFEINE INTAKE BY LCAC CREW

	Caffeine (n=13)	Caffeine (n=7)
Acceptable intake level	< 200	
Mean (mg)	175.	310.7
+ SD	290.6	346.8

Discussion. The dietary data collected from subjects aboard LCACs reveal several areas of concern. First, diets consumed by LCAC crew are deficient in available energy when compared to the established MRDA's for adult males. The low caloric intake can be attributed to the intense operational schedule of these LCAC personnel. Because 70% of the training exercises occur at night and continue through the early morning hours, the crew members in this study slept through galley breakfast hours. At other times, operational exercises begin in the early morning hours. LCAC crew participating in these morning mission exercises generally will miss breakfast as well. The loosely structured food distribution and irregular meal consumption documented during this study was validated by LCAC crew personnel histories and surveys. It is apparent that LCAC crew cannot rely on a regular meal cycle during high-tempo operations. Continued negative energy balance can result in adverse changes in physiologic and mental performance during sustained operations, as well as changes in body weight and/or body composition. It is therefore necessary to provide alternative meal sources to ensure adequate caloric intake. This need is accentuated during high-tempo operation cycles.

Analysis of the records indicated deficiencies for a significant number of nutrients. This would appear to be due to the overall low food intake, as well as the lack of availability of fresh fruits and vegetables. The calories derived from fat and protein were high, and those from carbohydrates low, compared to the guidelines established for Americans to maximize health benefits and minimize health risks through proper eating habits. The high fat intake may be due to the consumption of fried foods from the galley service as well as the current practice of LCAC crew bringing aboard commercially packaged foods high in protein and fat, and low in carbohydrates. Increasing caloric intake and consumption of fruits, vegetables, and complex carbohydrates in the form of unrefined pasta, rice, and cereal should be encouraged, while consumption of fried foods should be reduced.

Several subjects consumed moderate levels of caffeine. While caffeine can maintain wakefulness and alertness, it can have adverse effects. Negative effects of caffeine intake in the range of 200-500 mg include headaches, tremors, nervousness, diuresis (increased urine production), and cardiac arrhythmias (Lombardo, 1986).

Subjects disclosed their purposeful restriction of additional fluid intake to counteract the diuretic effect of caffeine and avoid the need to urinate during their shifts (there are no urinals in LCAC cabin spaces). This may explain in part the overall low fluid intake during the data collection period. Furthermore, there is no water source for operators in the starboard compartment. LCAC crew are forced to bring their own drinks aboard during missions, which are often times caffeinated beverages. Restriction of fluid intake can lead to dehydration with detrimental effects on physical performance, mental concentration, and body temperature regulation (Mahan and Arlin, 1992).

Recommendations. Based on the data from this present study, the following dietary recommendations are made:

- A. During sustained operations, LCAC crews should be provided with regularly scheduled meals from the galley. Missed meals was a key factor in the low caloric intake of the subjects.
- B. Foods high in complex carbohydrates including pasta, rice, cereals, fruits and vegetables should be made available from the galley to LCAC crews and consumption of such foods should be encouraged.
- C. Food rations such as MREs should be made available aboard the LCAC in the event that operations are extended and return is delayed (reported to be a frequent event).
- D. Provide a urinal or "relief tube" aboard the LCAC. LCAC crews will be less likely to restrict fluid if they are able to urinate during their under-way periods.
- E. To increase fluid intake an accessible water source should be installed aboard, possibly in the starboard compartment.

Sleep Logs

Design and Procedure. Sleep records were completed by 31 crew members and covered the reporting period of day two through day three of the operational training

exercise. Table 8 lists the number of personnel and their crew position who participated in maintaining a sleep log.

TABLE 8
LCAC PERSONNEL PARTICIPATING IN SLEEP LOG

Craftmasters (CM)	=8
Engineers (ENG)	=5
Navigators (NAV)	=6
Deck Mechanic (DM)	=5
Loadmaster (LM)	=7
Total	=31

The sleep records covered the following areas:

1. Level of functioning - A self rating from (1) "Feeling active, vital, alert, wide awake" to (7) "Almost in reverie; sleep onset soon; losing struggle to remain awake."
2. Hours of sleep - Total number of sleep hours in the last twenty four hour period, rounded to the nearest whole hour.
3. Feeling rested - A self rating from (1) "Well rested" to (4) "Not rested at all."
4. Number of hours worked - Total number of work hours in the last twenty four hour period, rounded to the nearest whole hour.

The crew reported an average of 16.1 hours of work (crew day), and had 6.3 hours of sleep per 24 hours. Fifty eight percent reported feeling "Moderately rested" and 29 % (NAV=3, DM=2, LM=4) reported feeling "Slightly rested." Only four crew members reported that they were either "Well rested" (n=2) or "Not at all rested" (n=2). Overall, the crew members reported a Level of Functioning of 2.7 which falls between (2) "Functioning at a high level, but not at peak; able to concentrate" and (3) "Relaxed; awake, responsive, but not at full alertness."

Discussion. Some general statements can be made on the basis of this information, although the small size of the study population and the relatively short period of observation preclude any meaningful statistical analysis or in-depth inference. The results of this survey would indicate generally long work hours over this exercise period. Fatigue was felt to have been one contributing factor to a minor collision between one

LCAC and several parked Marine vehicles during a beach approach late on the second day of operations. Sleep duration was acceptable overall, although this total would have been decreased noticeably had the Detachment OIC not canceled the AM operation of the third day. The self ratings of Feeling Rested are consistent with the work/rest schedule. The Level of Function of 2.7 is less than optimal, but consistent with the high tempo operating schedule during this period of observation. Overall, this information indicates a moderately stressful operating schedule from the standpoint of work/rest cycles, but one relatively well tolerated by the responding crew personnel. These data would suggest that physically very-fit individuals, who are less likely to suffer from the increased demands of such an operational schedule, should be selected for LCAC duty, and that a high priority be given by the unit OIC/CO to monitoring the performance/fatigue level of LCAC crews.

Equipment Factors

Vision and Night Vision

Night vision devices were used frequently during missions by all crew members in the starboard cabin, with the pattern of use depending upon the crew. Cockpit lighting did impair but did not prevent use of NVG.

Failure of windscreen washers while in billowing dust during a night beach landing approach was thought to be one of the factors (along with fatigue, noted earlier) contributing to a collision between an LCAC and parked Marine vehicles during that approach.

The importance of visual cues to navigation and all phases of LCAC operations were apparent to both investigators. Comments were made by crew members regarding the need for some means to improve visual reference and night vision.

Safety Equipment

Safety and protective equipment (goggles, earplugs, " earmuffs," helmets, nomex clothing, etc.) was consistently used by all crew members. Crew members were particularly attentive to hearing protection, which appeared to be most necessary in the well deck. Crew members commented that prescription eye wear in aviation frames would fit better with their headphone gear; however, prescription eyewear in these type

frames were not being issued to LCAC personnel. Crew members had to purchase this particular eyewear on their own.

Communications Equipment

There was a heavy reliance upon electronic communications aboard all LCAC, both for operations and safety. This included maintaining close communication while in the well deck, particularly when air cushions were "powered up." All passengers without headphone communication capability were kept in cabin spaces or in their vehicles.

DISCUSSION

Operational Factors

During this combined fleet exercise, a long LCAC crew day and high intensity schedule was maintained, particularly during days 1 and 2. Continuous sorties were the rule on the first two days, with noticeable crew fatigue forcing cancellation of planned AM LCAC operations on day 3 in the interest of safety. It is almost certain that in a combat situation such a cancellation would not have occurred. Mission tasking was heavy on days 1 and 2, but LCAC crew maintained equipment and personnel transfers on schedule.

Physiological Factors

Nutrition/Hydration

Although the number of subjects in this substudy was small and the period of observation short, some interesting and potentially valuable information was derived. It would appear that the high intensity operating schedule significantly interferes with the LCAC crew's ability to get regular nutrition. This was underscored by an incident involving NAVHLTHRSCHCEN researchers when the LCACs they were observing on day 2 were stalled on the beach at night for five hours awaiting the arrival of Marine equipment. On that occasion, MREs obtained (at 2100) from Marine units were the only rations available to LCAC personnel.

Craft design with lack of provision for urination underway may also contribute to inadequate hydration or intentional dehydration by crew members.

Caffeine use by LCAC crew members is prevalent, and may also contribute to dehydration. However, studies of pre- and post-mission hydration of LCAC crew have not been performed.

Sleep

The sleep questionnaires completed by participants during this exercise indicated that work hours per 24-hour day were generally long, with short but minimally adequate sleep periods. Had the AM exercise on day 3 not been canceled, the preceding sleep period would have been less than four hours long (following two long days of operations). There was also indication that in general, these personnel remained somewhat fatigued throughout operations. This was also stated to researchers informally by crew personnel during this exercise.

Motion Sickness

There were no reports among LCAC crew personnel of motion sickness during this exercise, despite an increased sea state on the evening of day 2.

Equipment Factors

Vision factors dominated the list of equipment-related issues. Night vision was an important factor, as was the use of NVG. The lack of standardized training or uniform pattern of NVG use was obvious, and raises the question whether this (rather expensive) equipment is being used to its best advantage. The importance of vision as a selection criteria was supported.

Communications and communication-related equipment took second place in obvious concerns. There is a high reliance on verbal communication and electronic systems to support this. Obvious safety issues apply to maintenance of close communications. The importance of hearing and speech capabilities in selection criteria was made quite clear.

SECTION 4. LCAC CREW MEDICAL SURVEY

INTRODUCTION

In developing permanent medical selection standards for LCAC crew members, the investigators followed a five step process, including a crew survey at both East and West coast ACU's to evaluate the importance of previously identified medical and physical selection issues to experienced LCAC crew personnel. These issues included specific physical characteristics for selection such as visual performance, and general health including psychological aspects. These surveys confirmed many preliminary impressions developed during our observations regarding significant physical selection and medical fitness items, and the survey results aided in developing the final set of medical selection and operational medical standards.

METHODS

Based on the information gathered from the informal interviews and from the research observations during the amphibious exercise, a medical survey (MS) was developed. This survey was used to determine the degree of importance of each identified issue. Many crew members who completed this survey had extensive operational experience, since they had participated in Desert Shield/Desert Storm and the relief efforts in Bangladesh, immediately following Operation Desert Storm.

This survey consisted of 23 numbered items, some of which allowed multiple responses, for a total of 52 responses. One final "Open Response" item was included, requesting additional comments or other perceived areas of concern. The topics were broken down into six topic areas with varying methods of responding to help ensure candid, useful answers:

General Topics (Items 1-11)

Items included such topics as meeting USN Percent-body-fat limits, communications skills, vision and hearing. The subjects responded to the question "Based on YOUR EXPERIENCE AS A DECK ENGINEER (or other crew position) ON LCACs, how important are each of the following areas when ACTUALLY PERFORMING YOUR DUTIES?" Subjects rated the importance of each included item on a scale of 1 "Not

important" to 4 "Critically important." Subjects were asked to respond "Yes" or "No" to the question "Should medical waivers be considered for this?" for each item.

Motion Sickness (Items 12-15)

Subjects were asked to report the percentage of LCAC missions in which sea-states or conditions that caused motion sickness, to define the location(s) in the LCAC where motion sickness occurred, and to rate the severity of the occurrences for each area of the LCAC. A severity scale from 1 "NO EFFECT" to 4 "VERY GREAT EFFECT" was offered for these items.

Medications (Items 16-17)

These items asked the subjects to respond to two statements about medications allowable during LCAC operations to prevent/treat motion sickness and cold symptoms. The response scale given was from 1 "STRONGLY DISAGREE" to 4 "STRONGLY AGREE."

Stress (Items 18-19)

Subjects compared the stress levels of LCAC operations to other jobs that they have had in the Navy on a scale of 1 "MUCH LESS STRESSFUL" to 4 "MUCH MORE STRESSFUL." They were also asked to rate the importance of managing this stress on a scale of 1 "NOT AT ALL IMPORTANT" to 4 "CRITICALLY IMPORTANT."

Pre-Existing Medical Conditions (Item 20)

This item asked the subject to estimate the effect of various pre-existing medical conditions (such as chronic allergies, hypoglycemia) on the ability of crew members to accomplish their tasks. The response scale was again, 1 "NO EFFECT" to 4 "VERY GREAT EFFECT."

Operational Issues (Items 21-22)

This section asked the subjects to rate the effect of various issues such as "Adequate pre-mission sleep (6-8 hrs)" on their ability to perform their duties during "normal ops (less than 8-hour missions)." The scale was the same as used in item 20. Subjects also reported the percentage of normal operations that affected this factor.

Open Response (Item 23)

In this final item, the subjects were given the opportunity to address any issues that were not previously addressed or were felt to need more discussion.

Subjects were 130 male U.S. Navy volunteers, and all were LCAC crew members from East and West Coast ACUs. All were qualified crew members with *varying degrees of experience*. The MS was administered in group settings at each ACU. The investigators thoroughly explained the reasons for the survey and the importance of honest, candid answers to all prospective participants. The subjects read "Information to Participants," and signed standard participation consent forms. The MS was color coded to identify crew position (Craftmaster, Navigator, etc); otherwise, subject's responses were kept anonymous.

All data were analyzed by crew position. Both overall and group means were calculated for those responses in which percentages were reported. For items in which a scaled response was used, the number of responses for each value was calculated and used to rank the relative importance of various issues discussed. Again, both overall and group rankings were examined.

RESULTS

Vision

For every crew position, "Night Vision" was ranked as a visual capability very critical to mission accomplishment. "Normal Color Vision" was also ranked at a similar criticality level to night vision for most crew members, which was followed by "Normal Depth Perception" as the next most critical physical attribute for most crew members. A complete response breakdown is shown in Table 9 for each crew position. Table 10 contains the same results, but the results are collapsed across crew positions.

TABLE 9
IMPORTANCE OF VARIOUS VISION ISSUES IN
COMPLETION OF LCAC DUTIES AS RATED BY CREW POSITIONS

How important are each of the following areas when actually performing your duties?	Not important			Critically Important	Should medical waivers be considered for this?	
	1	2	3	4	YES	NO
CRAFTMASTERS						
DISTANT VISION CORRECTABLE TO 20/20	0	2	4	17	5	18
NEAR VISION CORRECTABLE TO 20/20	0	1	4	18	6	17
NORMAL DEPTH PERCEPTION	1	0	3	19	2	21
NORMAL COLOR VISION	0	2	3	18	3	20
NORMAL NIGHT VISION	0	1	2	20	2	21
NORMAL PERIPHERAL VISION	0	3	4	16	6	17
ENGINEERS						
DISTANT VISION CORRECTABLE TO 20/20	2	1	8	11	6	15
NEAR VISION CORRECTABLE TO 20/20	2	1	7	12	6	14
NORMAL DEPTH PERCEPTION	0	0	10	12	3	19
NORMAL COLOR VISION	0	1	3	18	2	20
NORMAL NIGHT VISION	0	0	4	18	2	20
NORMAL PERIPHERAL VISION	0	1	7	14	5	17
NAVIGATORS						
DISTANT VISION CORRECTABLE TO 20/20	0	2	6	20	11	17
NEAR VISION CORRECTABLE TO 20/20	0	2	11	15	11	17
NORMAL DEPTH PERCEPTION	0	0	10	18	5	23
NORMAL COLOR VISION	0	1	7	20	5	23
NORMAL NIGHT VISION	0	0	5	23	2	26
NORMAL PERIPHERAL VISION	0	3	14	11	11	17
LOADMASTERS						
DISTANT VISION CORRECTABLE TO 20/20	0	1	4	21	8	15
NEAR VISION CORRECTABLE TO 20/20	0	4	6	16	8	14
NORMAL DEPTH PERCEPTION	0	2	3	21	6	17
NORMAL COLOR VISION	0	2	3	21	4	19
NORMAL NIGHT VISION	0	1	4	21	2	21
NORMAL PERIPHERAL VISION	0	3	3	20	5	18
DECK ENGINEERS						
DISTANT VISION CORRECTABLE TO 20/20	1	4	15	11	14	11
NEAR VISION CORRECTABLE TO 20/20	1	4	17	9	17	8
NORMAL DEPTH PERCEPTION	1	3	16	11	10	13
NORMAL COLOR VISION	1	4	14	12	11	15
NORMAL NIGHT VISION	2	0	12	17	8	17
NORMAL PERIPHERAL VISION	2	1	16	12	8	17

Table 10 shows the vision results as a pooled group of all subjects.

TABLE 10
IMPORTANCE OF VARIOUS VISION ISSUES, ALL SUBJECTS.

How important are each of the following areas when actually performing your duties?	Not important			Critically Important	Should medical waivers be considered for this?	
	1	2	3		YES	NO
DISTANT VISION CORRECTABLE TO 20/20	3	10	37	80	44	76
NEAR VISION CORRECTABLE TO 20/20	3	12	45	70	48	70
NORMAL DEPTH PERCEPTION	2	5	42	81	26	93
NORMAL COLOR VISION	1	10	30	89	25	97
NORMAL NIGHT VISION	2	2	27	99	16	105
NORMAL PERIPHERAL VISION	2	11	44	73	35	86

Motion Sickness

The overall reported incidence of motion sickness was lower than anticipated. When occurrences were reported as a percentage of total missions, the overall (all crew position) average was only 7.1%. The break down by crew position is provided in Table 11. The location with the highest reported percentage of motion sickness was the Port/Lower cabin, and the highest rate of motion sickness per crew positions described by the Deck Engineers and Loadmasters. In the starboard cabin, the highest incidence of motion sickness was reported by the Navigators (see Table 11).

TABLE 11
PERCENT OF TOTAL MISSIONS WITH MOTION SICKNESS
BY CREW POSITION AND LOCATION. RECOMMENDATIONS AS TO
DISQUALIFYING CANDIDATES WITH HISTORY OF MOTION SICKNESS.

	STBD/ UPPER	STBD/ LOWER	PORT/ BUBBLE	PORT/ LOWER	OTHER	RECOMMEND DISQUALIFYING CANDIDATES FOR MOTION SICKNESS?	
						YES	NO
ALL SUBJECTS	2.3	6.3	2.7	7.2	1.4	78	50
CRAFTMASTERS	(0.7)	0.9	**	**	0.0	19	04
ENGINEERS	(1.8)	10.1	**	**	0.0	13	09
NAVIGATORS	(5.0)	9.6	**	**	0.0	19	08
DECK-ENGRS	**	**	7.4	(14.1)	7.7	13	18
LOADMASTERS	**	**	(0.1)	11.0	0.0	14	11

** - Not reported. Crew members not expected to normally be in this area.

() - Denotes percent motion sickness experience at normal crew position.

In most cases, the severity of the occurrence was rated as having "No Effect" on duty performance. The two locations that had the highest number of "Very Great Effect" ratings were the Starboard/upper cabin and the Port/lower cabin (only 6 and 4 cases respectively). A complete breakdown is shown in Table 12.

TABLE 12
SEVERITY OF MOTION SICKNESS BY LOCATION

	NO EFFECT 1	2	3	VERY GREAT EFFECT 4
STARBOARD / UPPER	62	5	4	(6)
STARBOARD / LOWER	71	7	5	3
PORT / BUBBLE	69	6	5	3
PORT / LOWER	66	18	5	(4)
OTHER	49	2	0	2

()- Denotes most severe experiences of motion sickness.

Although occurrences of motion sickness were reported as relatively infrequent, and the severity reported as insufficient to affect duty performance, a majority of crew members recommended that medications be made available to prevent/treat motion sickness (Table 13).

TABLE 13
RECOMMENDATIONS AS TO APPROVING MEDICATIONS
TO PREVENT/TREAT MOTION SICKNESS BY CREW POSITION

"The navy should approve one or more medications to prevent / treat motion sickness which would allow you to perform your duties safely."				
	STRONGLY DISAGREE 1	2	3	STRONGLY AGREE 4
ALL SUBJECTS	11	17	51	48
CRAFTMASTERS	5	2	8	8
ENGINEERS	1	4	9	7
NAVIGATORS	2	3	10	11
DECK-MECHS	1	3	16	11
LOADMASTERS	2	5	8	11

Communications and Hearing

Communications and hearing abilities were both rated as critically important. The ability to speak clearly and distinctly, and to have normal hearing were both rated highly. In addition, most crew members felt that waivers should not be considered for this. Results are demonstrated in Table 14.

TABLE 14
IMPORTANCE IN THE ABILITY TO SPEAK CLEARLY AND TO HEAR NORMALLY

"How important are each of the following areas when actually performing your duties?"						
	NOT IMPORTANT			CRITICALLY IMPORTANT	Should Medical Waivers Be Considered For This?	
	1	2	3	4	YES	NO
Speaking clearly & distinctly without accent	3	16	48	63	37	77
Speaking clearly & distinctly without speech impediment	1	4	47	78	19	97
Other crew members speaking clearly and distinctly without accent or speech impediment	1	13	55	61	**	**
Having normal hearing	2	5	49	74	22	100

** not recorded

Summary of Critical Physical Characteristics

Table 15 provides a summary of the topmost important physical factors that were expressed by LCAC crew members. They are listed both as a group and by crew position. The rank ordering of the important physical factors varies for each crew position. However, good night vision was expressed by all crew members as the most important physical characteristic needed.

TABLE 15

TOPMOST IMPORTANT PHYSICAL FACTORS EXPRESSED BY LCAC CREW MEMBERS

ALL CREWMEMBERS	CRAFTMASTER
1) NIGHT VISION 2) COLOR VISION 3) DEPTH PERCEPTION 4) HEARING 5) DISTANT VISION 6) PERIPHERAL VISION 7) NEAR VISION 8) OTHERS SPEAK CLEARLY 9) SPEAK WITHOUT ACCENT 10) PERCENT BODY FAT	1) NIGHT VISION 2) NO SPEECH IMPEDIMENT/NEAR VISION/ DEPTH PERCEPTION 3) COLOR VISION 4) DISTANT VISION 5) OTHERS SPEAK CLEARLY/PERIPHERAL VISION 6) HEARING 7) SPEAK WITHOUT ACCENT 8) PERCENT BODY FAT
ENGINEER	NAVIGATOR
1) NIGHT VISION 2) COLOR VISION 3) HEARING 4) PERIPHERAL VISION 5) DEPTH PERCEPTION 6) NO SPEECH IMPEDIMENT 7) SPEAK WITHOUT ACCENT 8) OTHERS SPEAK CLEARLY 9) DISTANT VISION 10) PERCENT BODY FAT	1) NIGHT VISION 2) NO SPEECH IMPEDIMENT 3) COLOR VISION 4) DISTANT VISION/DEPTH PERCEPTION 5) HEARING 6) SPEAK WITHOUT ACCENT/NEAR VISION 7) OTHERS SPEAK CLEARLY 8) PERIPHERAL VISION/NEAR VISION 9) PERIPHERAL VISION 10) PERCENT BODY FAT
DECK MECHANICS	LOADMASTER
1) NIGHT VISION 2) NO SPEECH IMPEDIMENT 3) PERIPHERAL VISION/HEARING 4) DEPTH PERCEPTION/COLOR VISION 5) SPEAK WITHOUT ACCENT/DISTANT VISION 6) OTHERS SPEAK CLEARLY 7) NEAR VISION 8) PERCENT BODY FAT	1) DISTANT VISION/NIGHT VISION 2) DEPTH PERCEPTION/COLOR VISION 3) PERIPHERAL VISION/HEARING 4) NO SPEECH IMPEDIMENT 5) NEAR VISION 6) OTHERS SPEAK CLEARLY 7) PERCENT BODY FAT 8) SPEAK WITHOUT ACCENT

Other Operational/Medical Issues

Some concern was shown for meeting the Navy's standards for allowable body fat. As demonstrated in Table 16, most crew members felt that meeting these standards was important or critically important. In addition, a majority recommend NOT waiving this criteria.

TABLE 16
IMPORTANCE OF MEETING USN PERCENT BODY FAT STANDARDS

How important is it to meet USN % Body Fat standards (per OPNAVINST 6100.1c)?					
NOT IMPORTANT			CRITICALLY IMPORTANT	SHOULD MEDICAL WAIVERS BE CONSIDERED FOR THIS?	
1	2	3	4	YES	NO
12	23	66	29	44	81

Medications

As discussed earlier, concern has been raised about the availability of medications to treat colds and congestion in operational LCAC crews. Table 17 shows that more than half of the crew members surveyed strongly agreed that more medications should be made available to LCAC crew members.

TABLE 17
**WHETHER OR NOT THE USN SHOULD APPROVE
MORE MEDICATIONS TO TREAT COLD SYMPTOMS**

	STRONGLY DISAGREE			STRONGLY AGREE
	1	2	3	4
The Navy should approve more medications to treat cold symptoms (i.e., runny nose, stuffy head) which could be taken during LCAC operations	15	20	42	52

Stress

A majority of the crew members felt that the duties involved in LCAC operations are more stressful than other jobs they previously had in the Navy, and that it was critically important to a majority of them to be able to manage this stress while performing their duties. These results, shown in Table 18, support earlier discussions with crew members and observations during the amphibious deployment.

TABLE 18
RELATIVE STRESS OF LCAC DUTIES TO OTHER JOBS HELD IN USN

	MUCH LESS STRESSFUL			MUCH MORE STRESSFUL
	1	2	3	4
When compared to other jobs that you have had in the Navy, would you say that your duties in operating LCACs are:	6	24	53	47
	NOT AT ALL IMPORTANT			CRITICALLY IMPORTANT
	1	2	3	4
How important is it to be able to manage this stress while performing your duties?	3	6	39	82

Pre-Existing Medical Conditions

Table 19 shows the crew members predictions of the effect of various pre-existing medical conditions on performance. A history of recurrent low back pain was identified by crew members as being of considerable concern. It was felt by a majority of respondents that a history of this problem would have "VERY GREAT EFFECT" on a crew members ability to perform duties.

TABLE 19
**PREDICTED EFFECT OF PRE-EXISTING MEDICAL
CONDITIONS ON ABILITY TO PERFORM LCAC DUTIES**

IF A CREW MEMBER SERVING IN YOUR POSITION WERE TO HAVE ANY OF THE FOLLOWING CONDITIONS, HOW MUCH EFFECT WOULD IT HAVE ON THEIR ABILITY TO PERFORM ALL NECESSARY DUTIES (KEEPING IN MIND OPERATIONS CONDITIONS SUCH AS MISSION LENGTH, AVAILABILITY OF FOOD, WATER & REST)				
	NO EFFECT			VERY GREAT EFFECT
	1	2	3	4
CHRONIC ALLERGIES	10	43	48	27
ULCERS	11	42	49	27
LOW BLOOD SUGAR	7	39	46	34
RECURRENT LOWER BACK PAIN	3	13	43	70
EATING DISORDERS	13	34	44	36

Open Response

Many of the comments made on this item had to do with medical issues already covered in the survey. There were several new areas in which comments or suggestions were offered. These included:

Human factors Engineering

There are no toilet facilities on LCACs, and crew members must use creative means (often times a bucket) to overcome this problem, especially during extended operations.

It was suggested that the seats in the starboard cabin be redesigned to provide more lower back support. This reinforces crew members' concern regarding screening LCAC crew candidates for lower back problems.

Stress management/health maintenance

Many respondents re-emphasized the need for crew members to have the ability to concentrate and focus on their duties under crisis or stress. Also cited was the ability to manage three or four separate tasks simultaneously. Several respondents reinforced the need to be able to "manage stress" in general.

It was suggested that a command-supported, physical training or aerobics conditioning program would not only help in stress management, but also would enhance crew well-being, and would ultimately improve crew performance.

Allergic reactions

Several subjects pointed out that personnel should be screened for allergic reactions to some of the products routinely used by LCAC crews, such as "Lube Oil-23699."

Crew member size

The most surprising comments were made regarding the physical size of crew members, especially the Deck Mechanics and Loadmasters. Several subjects pointed out that very large (tall and/or fat) Deck Mechanics or Loadmasters are not able to get into tight below-deck spaces (tunnels) or fit inside the bow-thrusters when it is necessary. Suggestions were made that both crew positions should be filled with "smaller" stature crew, or at least "ones who are not over 6' tall."

DISCUSSION

Vision

Night vision was consistently rated as the single most critical visual (and non-visual) capability for LCAC crew candidates. The knowledge that a high percentage of missions are conducted at night, and that there is a high degree of dependence upon

visual cues for craft operation and mission success support these ratings. Currently, night vision screening is limited to questioning the candidate as to past difficulty with night vision. No means for objective testing is currently available for this characteristic. High rankings were given to other visual capabilities, including depth perception, color vision, and distant visual acuity by most crew positions. The high order of importance placed upon all these visual capabilities emphasizes their criticality in candidate screening, with an emphasis on personnel in the starboard cabin.

Motion Sickness

A relatively low overall incidence of motion sickness and its effect on LCAC operations was reported by crew members, especially the craft operators. Navigators reported the highest incidence in the starboard cabin, consistent with their attention to interior navigational gear and intermittent horizon fixation during craft operation. Not surprisingly, deck engineers reported the highest percentage of motion sickness of all crew positions. This is consistent with the more limited sea experience of these individuals and the almost complete lack of visual horizon cues to them in the lower port cabin when underway. The positive response by the majority ("Agree" or "Strongly Agree") to the question whether motion sickness medication should be approved for LCAC operations raises the possibility that the true incidence of motion sickness may have been under reported by respondents, or that the respondents consider it a more serious problem to performance than they indicated by survey choices.

Communication

Communication and hearing abilities were highly rated by all crew personnel. Considering the high degree of interdependence among LCAC crew personnel when underway, these results are not surprising. Of all crew positions, this would appear to be the most critical for the Navigator. Communication-related screening tests, including the audiogram and the read-aloud test (and the combined psychomotor/communication screening for Craftmasters and Engineers) are currently available.

Other Operational/Medical Issues

Body fat standards were considered surprisingly important to crew personnel, with approximately 3/4 of respondents rating it "Important" or "Critically Important", and 2/3 of participants recommending no medical waiver for this item. It is uncertain what

factors are operative in this ranking but the perception of the LCAC crew as an elite unit may enter into these choices.

Medications

There was general agreement that decongestants/"cold" medication in addition to that currently available should be approved for use by operational LCAC crews. These results confirmed information given in prior LCAC crew interviews, and indicates a real perceived need on the part of these personnel.

Stress

Most LCAC crew members indicated that LCAC crew duties were "More Stressful" or "Much More Stressful" than prior Navy assignments and that it was highly important to manage stress in the duty environment. These responses were consistent with LCAC crew interviews prior to this survey. What LCAC crews considered stressful included increased and multiple responsibilities, a complex maintenance schedule, and frequently long or extended work weeks. For these reasons, candidate psychological status and emotional stability is felt to be important to assess during the screening process, particularly for starboard-cabin, crew personnel.

Pre-Existing Medical Conditions

The highest ranking of these items, "recurrent low back pain," would appear to be an area of particular concern in LCAC candidate screening. This ranking corresponded to personnel comments during crew interviews regarding lower back symptoms. Other items related to allergies, ulcer disease, low blood sugar, and eating disorders were ranked to indicate an expectation of some effect upon duty performance by approximately 90% of respondents, and reinforces the impression that excellent overall health is important for all LCAC crew candidates.

Open Response Items

Human Factors Engineering: The fact that no provision has been made for crew urination underway was commented upon, and points out a factor that may actually contribute to degraded performance by its encouragement of dehydration in crew members. Lower back concerns were further emphasized by comments regarding seat back redesign to increase back support. These both seem to be valid issues.

Stress Management/Health Maintenance: The need for stress management abilities in LCAC crew personnel was reiterated, and reinforces the impression that only psychologically stable personnel be selected for LCAC crew positions.

Crew Member Size: A previously unrecognized issue of establishing a maximum crew member stature/size was expressed by several respondents. This issue would seem to have validity, and a real effect on job performance in the Deck Mechanic crew position.

RECOMMENDATIONS

After completing the above surveys and observations, the information collected relevant to physical selection standards and operational medical guidelines was discussed with consultants from the Bureau of Medicine and Surgery (MED-22), the Naval Aerospace Medical Institute (Code 26 and Code 42), and medical and command personnel from both East and West coast ACUs. Their input was included in a set of proposed LCAC candidate physical selection standards and proposed medical operational guidelines for the SEAOPS manual. These proposed standards and guidelines (Appendix 1) and the rationale for their acceptance (Appendix 2) were forwarded to TYCOMs, BUMED, both ACUs and NAVSEA for their review and comments prior to the 9 Jun 1992 LCAC Fleet Support Conference at Camp Pendleton, CA. Further input at the time of and following the conference resulted in the final set of candidate physical selection standards found in Change 107 of the Manual of the Medical Department (Appendix 3).

Additional Recommendations

1. Provide a means for urinary relief while underway.
2. Provide a source of liquids in starboard cabin.
3. Provide emergency rations on board craft.
4. Redesign seats in starboard cabin.
5. Ensure that support ships give appropriate attention to LCAC crews' need of a regular food supply.

PART I REFERENCES

- Cutler, T.J. (1988). *Brown Water, Black Berets*. New York: Simon & Schuster, Inc.
- Department of the Navy. (1990). *Safe Engineering and Operations (SEAOPS) Manual for Training Standardization and Evaluation Crewmember Qualification Landing Craft Air Cushion (LCAC) (S9LCAAA-SSM-030)*.
- Klein, J. (1989). Surface Sailors. *Fathom: Afloat Safety Review*, Oct/Nov, pp. 20-23.
- Lombardo, J.A. (1986). Stimulants and athletic performance (part 1 of 2): Amphetamines and caffeine. *The Physician and Sportsmedicine*, 14, pp. 128-140.
- Mahan, L.K., & Arlin, M. (1992). *Krause's Food, Nutrition and Diet Therapy* (8th ed.). Philadelphia: W.B. Saunders Co.
- McKearney, T.J. (1987, November). Launching the new assault wave. *Proceedings of the U.S. Naval Institute*, 113, 11.
- Nutrition allowances, standards and education. (1985). Army Regulation 40-25/Naval Command Medical Instruction 10110.1/Air Force Regulation. pp. 160-195.
- Nutrition Committee, American Heart Association. (1986). Dietary Guidelines for Healthy American Adults. *Circulation*, 74, pp. 1465A-1468A.
- Schlichting, H. (1991). Presentation. *Proceedings of the Landing Craft, Air Cushion (LCAC) Crew Medical Standards Conference*, 15-16 January. San Diego: Naval Health Research Center.
- Subcommittee on the Tenth Edition of the RDAs, Food and Nutrition Board, Commission on Life Sciences, National Research Council. (1989). *Recommended Dietary Allowances* (10th rev. ed.). Washington, DC: National Academy Press.

PART II. TASK ANALYSIS OF THE LANDING CRAFT AIR CUSHION (LCAC) CREW POSITIONS

INTRODUCTION

The purpose of the task analysis of LCAC crew positions is to develop detailed and valid information about the work performed by LCAC crew. The results of the task analysis answer the following questions.

- What tasks are performed by each of the five LCAC crew positions?
- Which tasks are the most difficult to learn how to perform (and which are considered to be the easiest to learn how to perform)?
- Which tasks are the most important to overall mission success (and which are the least important)?
- What are the skills and abilities that are critical to successful task performance in each of the crew positions (and which skills and abilities are less important)?

The results of the task analysis can be compared to the interim LCAC crew personnel selection and fitness for duty standards to determine if the established medical criteria are relevant to the skills and abilities required for successful job performance. The results presented here can also be used by curriculum developers and trainers to ensure that appropriate training effort is devoted to the tasks and procedures that are the most difficult to learn how to perform, and to those that are critical to mission success. The results of the task analysis can also indicate procedural and equipment design problems.

This part of the report begins with a brief summary of LCAC operations, crew responsibilities, and the most salient human factors issues associated with LCAC operations. Next, the primary research tasks performed during the study are described, followed by a presentation of the results of the task analysis. Task analysis results are presented individually for each of the five LCAC crew positions and the key abilities required for successful job performance in each crew position are identified and discussed. Part II concludes with a set of recommendations based on the results of the task and ability analysis.

BACKGROUND

The LCAC has been a remarkable addition to the Navy's inventory, and has revolutionized the manner in which amphibious assaults are conducted. LCACs played a major role in Operation Desert Storm without even placing a Marine on the beach; the threat of an amphibious assault by LCACs maneuvering offshore was sufficient to maintain the attention of more than 100,000 elite Iraqi troops, preventing them from entering the land battle (Holzer, 1992). Following Desert Storm, LCACs were deployed to rescue and provide relief supplies to 1.8 million cyclone survivors in Bangladesh. Many survivors would have perished if it were not for dedicated crew personnel and the LCACs' unique capabilities to reach otherwise inaccessible areas.

LCACs possess awesome capabilities. Operating at high surface speeds from launch points over the horizon (OTH), LCACs can deliver equipment and personnel to 80 percent of the world's beaches without the necessity of detailed hydrographic surveys of boat lanes, as is required for conventional assaults. LCACs can reach the beach from their OTH launch points in about the same time that a conventional craft can traverse the standard 5,000 to 10,000-yard boat lane (McKearney, 1987). Furthermore, turnaround times are greatly reduced by the LCAC's unique capability to "fly" into and out of a well-deck without mothership ballasting and deballasting. In short, the primary benefits of LCAC technology are derived from the flexibility and quickened pace of LCAC operations. But what are the special medical, physiological or human factors requirements necessary in order to achieve the LCAC's significant benefits?

LCAC Crew Positions and Responsibilities

An LCAC crew is composed of five specialists who work together as a team to operate their high-performance craft. Figure 3 provides a simplified general layout of an LCAC to illustrate the locations of the five crew positions. The Craftmaster (operator), Engineer, and Navigator occupy a "flight deck" type pilot house on the upper level of the starboard cabin. The Loadmaster and Deck Mechanic positions are in the port cabin: the loadmaster's chair is mounted so that the Loadmaster's head occupies a small windowed cupola atop the port cabin, while the Deck Mechanic sits below in the passenger compartment. About 24 passengers can be carried by an LCAC in addition to the five crew members (16 in the port cabin, with the Loadmaster and Deck Mechanic, and eight on the lower level of the starboard cabin). The LCAC's high surface speed, large ducted propellers, turbine engines and other equipment render the

deck of an LCAC an extremely dangerous place. For this reason, all passengers and crew must remain inside the relatively small port or starboard cabins during LCAC operation; additional passengers may be safely carried in armored vehicles that are secured to the LCAC's deck.

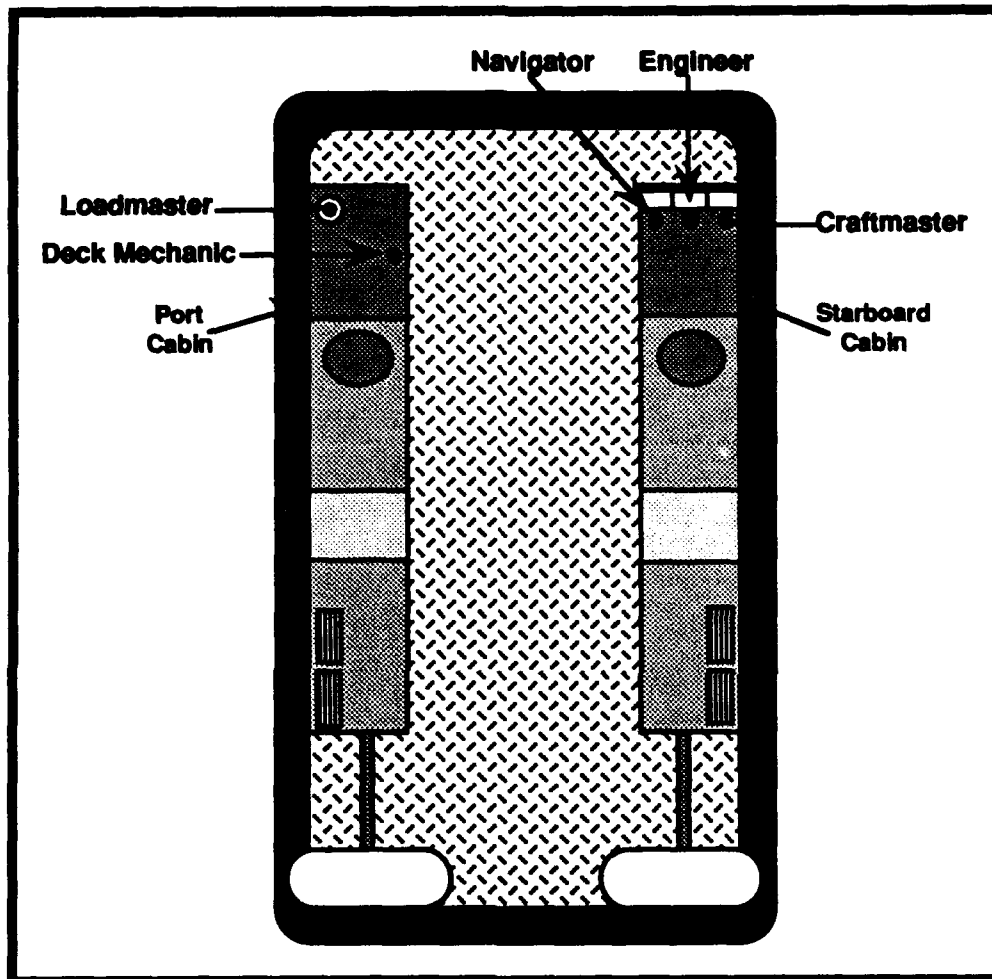


Figure 3. General layout of LCAC.

The *Craftmaster* is responsible for operating the LCAC and providing leadership to the crew. The *Engineer* is responsible for maintaining and monitoring the performance of all onboard equipment, and for maintaining the equipment-related logs and inventories. The Engineer is also the Assistant Craftmaster; that is, in addition to performance of his engineering duties, the engineer must be able to operate the LCAC in the event the Craftmaster is incapacitated. The *Navigator* is responsible for plotting courses and maintaining and monitoring navigation equipment. The Navigator is also the crew member responsible for maintaining the many personnel and training logs involved in LCAC operation; many of the records are maintained on personal computers ashore.

The *Loadmaster* is responsible for developing load plans, securing all deck cargo, and for monitoring the status of the cargo while under way. The Loadmaster also serves as the port side lookout. The *Deck Mechanic* (sometimes referred to as the deck engineer) works closely with the LCAC Engineer during start-up, shut-down, and maintenance procedures. Typically, the Deck Mechanic performs tasks at the direction of the engineer while the Engineer activates or adjusts system controls and monitors his displays on the flight deck console. The Deck Mechanic and Loadmaster also serve as line handlers during mooring and anchoring procedures.

All five LCAC crew personnel wear headsets and microphones to remain in constant communication with each other from pre-mission inspection through post-mission shut-down procedures. Crew personnel remain connected to the communications network while on deck performing their duties (i.e., only when the LCAC is off-cushion). Intra-crew communication is an essential part of LCAC work, dictated by the performance characteristics and the physical layout of the vessel. For example, the Craftmaster operates the LCAC's primary speed and direction controls from his console in response to navigation information provided by the Navigator and visual contact information provided by the Loadmaster and Engineer; the Engineer also provides a continuous stream of relevant information regarding the status of the power plants and other engineering systems. Furthermore, it is apparent from Figure 3 that the Craftmaster's field of view is limited to the areas directly in front of the craft and to starboard. For this reason, the Craftmaster is totally dependent on the observations of the Loadmaster for all visual information from the port side of the craft.

Visibility from all LCAC crew positions is degraded whenever the craft is underway. Sea spray generated by the lift rotors requires constant wiper action to clear the forward windows in the pilot house and the cupola atop the port cabin (the latter operated manually by the Loadmaster serving as the port lookout). Craftmaster, Engineer, and Navigator visibility is further degraded by the six large structural supports located in the forward 180 degree field of view from the flight deck; surface contacts are frequently occluded from a crew member's view by these structural supports. Visibility aft is limited to wet rear view mirrors, which are frequently damaged or lost during routine well-deck operations.

Vision and visibility difficulties are apparent even during the most routine LCAC beach approaches. Despite a crew's extreme skill, navigation aids, and familiarity with

the local coastline, nighttime approaches to a beach are typically accompanied by considerable deliberation regarding the location of the designated landing site. For example, it was observed on training missions that a red light beyond a highway running parallel to the beach was mistaken for a light known to be on the south side of the designated landing site. On another occasion, the Craftmaster missed the beach altogether by visual reference, but was corrected by the Navigator guided by his radar display. In short, visual information obtained by crew (looking through wet windows at night) must be shared quickly and accurately with the Craftmaster to ensure operational effectiveness.

Human factors research has demonstrated that workload is a key factor in causing human error. It has been established that human operators are most reliable under moderate levels of workload that do not change suddenly or unpredictably. Human operators experience difficulty processing the flood of information typical of extremely high workload conditions; the inability of an individual to process all available information when workload is too high contributes to the occurrence of operator errors. Conversely, when workload is too low, human operators can become bored and fail to attend properly to their tasks; an insufficient workload also contributes to the probability of human error (Kantowitz and Casper, 1988).

Beach and well-deck approaches are probably the operations in which the crew of LCACs experience the greatest workloads, and potentials for human error. A beach approach, for example, begins with a departure from the well-deck of an amphibious assault ship, a maneuver that requires precise movements of the LCAC despite significant response lag times. Following departure from the mother ship, a beach approach requires accurate navigation and visual acquisition of reference points to rendezvous and transit with other LCACs and to identify the correct landing site; identifying the landing site is typically a group activity, led by the Craftmaster. When the landing site has been identified, the Craftmaster must then make precise control inputs to select the most appropriate course to the beach. A few moments later he must estimate the intervals between the waves and align his craft at the proper angle to the beach to cross the surf zone at the correct interval--these estimates, decisions, and control adjustments must be made quickly. Before the LCAC reaches the beach, the Craftmaster (assisted by his crew) must also visually locate any obstacles or depressions that must be avoided. All of these tasks, including constant visual searches, decision-making, and control corrections (i.e., collective, foot pedals, yoke, etc.), are performed at relatively

fast surface speeds to permit the crew to take advantage of the LCAC's unique capabilities.

The high workload of a beach approach is evident in the tension exhibited by an LCAC crew as the craft nears its objective. Faces move closer to the windows in an instinctive attempt to improve visibility of the surf and beach features through the moisture and wiper blades. Speech is clipped and restricted to the words necessary to convey essential information: "...one-hundred yards to the beach...how's the trim...fifty yards...twenty-five yards...surf zone...feet dry, feet dry...hole in the sand on the port side!" Wipers are turned off by the Engineer when the craft reaches the beach to prevent the blowing sand from damaging the windows; for this reason, obstacles and hazards should be identified before the craft's "feet are dry."

The emphasis on visual tasks as a primary contributor to LCAC crew workload is apparent from subjective estimates reported by crew personnel. Most crew believe workload to be higher during nighttime operations, when visibility is further degraded, than during the day when there are far more surface contacts to identify and track. Commenting on the cumulative stress of high workloads, an experienced Craftmaster reported, "When you have made a couple of night approaches, you know that you have really worked."

A separate aspect of workload is the fatigue experienced by crew during continuous and sustained operations. Major training exercises conducted during deployments have involved continuous LCAC operations for 20 to 36 hours. During the exercises, LCAC crew are required to remain on board their craft with few opportunities for sleep; some personnel reported sleeping as little as three hours during a three day exercise. The 15 to 30 minutes required to load an LCAC once it is in a well-deck does not provide sufficient time for crew to obtain effective sleep. Fatigue from continuous operation appears to be a predictable result of LCAC technology. The principal advantages of the LCAC derive from the craft's rapid turnaround at the mothership and overall fast pace of operation; at least three loads can be delivered from OTH to the beach by an LCAC in the same time that a conventional landing craft can make two trips from an assault ship located inshore (McKearney, 1987).

The LCAC is well-designed to move quickly and frequently between ships located several miles offshore and the beach. The human costs of this capability are high

workloads, fatigue, and an increased propensity for human error. Most crew who have participated in sustained LCAC operations can cite examples of the effects of fatigue on performance. A Craftmaster reported that, "Fatigue causes you to do stupid things and to take short-cuts, like using two gripes (tie-downs) rather than four." Those familiar with actual combat operations know that the effects of fatigue are not limited to training exercises, and that fatigue can have catastrophic consequences.

RESEARCH SUMMARY

Initial interest in conducting a detailed task analysis of LCAC crew positions was part of the NHRC research initiative to develop medical standards for the selection and retention for duty of LCAC crew personnel. The effort to establish special medical standards for LCAC crew personnel was precipitated by the recognition of the many similarities between operating an LCAC and flying a helicopter or fixed wing aircraft. The LCACs' yoke, collective, and foot controls, response lag to control inputs, and high-performance propulsion systems have been cited as evidence that LCACs are more like aircraft than naval vessels. High surface speeds and advanced navigation and engineering displays contribute to the perception of similarity. LCAC operations are even called "flights," and the crew wear flightsuits.

Despite the clear similarities between LCAC operation and aviation there are fundamental differences that must be identified in order to fully understand the skills, knowledge, and capabilities required of LCAC crew. The principal differences between LCAC operation and aviation were discussed in detail at the LCAC Crew Medical Standards Conference (Stuster, 1991). It was recommended during the conference that formal analyses of the work performed by LCAC crew are necessary to ensure that appropriate medical standards are established. The results of the task analysis permit the developers of personnel selection procedures to compare the current selection criteria to the tasks, skills, and abilities that are critical to successful performance by LCAC crew. That is, it is possible to identify any mismatches between selection standards and job requirements. If necessary, it will also be possible to adjust the selection and fitness for duty criteria to reflect the relative importance of specific abilities to successful job performance.

Figure 4 presents the sequence of research activities performed as part of the task analysis.

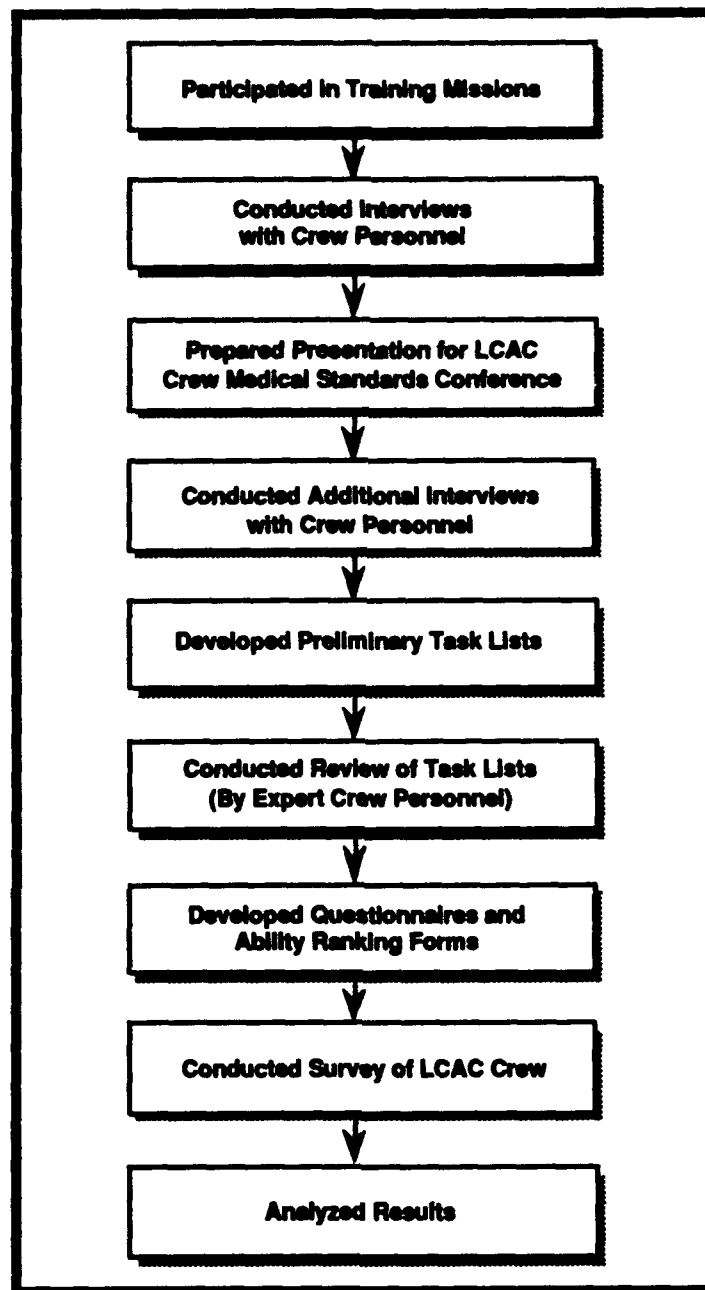


Figure 4. Research activities conducted during the task analysis.

The project began by researchers participating (as observers) in a series of four training missions conducted by Assault Craft Unit Five (ACU-5) from their base at Camp Pendleton. Three of the missions were conducted at night and one involved multiple well-deck approaches and landings. Researchers observed pre-mission briefings and vessel inspections, start-up procedures, ramp transits, off-shore operations, beach approaches and landings, and shut-down and clean-up procedures. Navigators and Engineers were also observed in the performance of their record-keeping duties.

The researchers usually took turns in jump seats on the flight deck (located behind the Engineer and Craftmaster), but periodically rode with the Deck Mechanic and loadmaster in the port cabin. Headsets were provided to the researchers, which permitted open-ended interviews to be conducted during, as well as before and after the training missions.

Papers based on the observations and interviews made during training missions were prepared for presentation at the LCAC Crew Medical Standards Conference. The final day of the conference was punctuated by announcements of the beginning of Operation Desert Storm (16 January 1991). At that time most LCACs had already been deployed for several months as part of Operation Desert Shield. As mentioned previously, LCACs contributed to the liberation of Kuwait by participating in a feigned amphibious landing.

Task Lists and Task Ranking

The research was resumed when the LCACs returned to Camp Pendleton following Operation Sea Angel (humanitarian assistance to the country of Bangladesh). Researchers participated in another training mission and conducted focused interviews regarding the specific tasks performed by the five crew positions. Training and maintenance documents were also reviewed for information concerning task performance. Preliminary task lists were then developed for the five crew positions and submitted to ACU-4 and ACU-5 for review by expert crew personnel. Experts reviewed the preliminary lists to ensure that the task inventories were comprehensive and technically accurate. All task statements followed the same format to facilitate systematic comparison; that is, each statement began with an action verb, followed by the object, equipment or person involved. For example:

Request and receive information from navigator regarding navigation issues.

It is important to note that the numbers of tasks for which each crew position is responsible greatly exceed what is normal for a job title in either the military or private industry. Most technical jobs can be described by a list of about 125 tasks. In contrast, the operational task lists (i.e., tasks involved in operating the vessel) for LCAC crew ranged from 113 (Deck Mechanic) to 195 tasks (Engineer); to this must be added the 154 separate preventive maintenance tasks that are performed by various members of an LCAC crew as part of the Preventive Maintenance System (PMS). In other words,

the work of an individual LCAC crew member encompasses the task responsibilities equivalent to two typical jobs (i.e., the number of tasks for which an incumbent is responsible, not necessarily the workload of two jobs).

Five separate questionnaires were developed, one for each crew position; the questionnaires incorporated the crew positions' final task lists. Questionnaires were administered to all available LCAC crew at ACU-4 and ACU-5. Two questions were asked about each task statement and LCAC crew personnel were instructed to respond by recording the number on the scales that best reflects their opinion and personal experience. Figure 5 illustrates the scales and questions that were reproduced at the top of each page of the task analysis questionnaires.

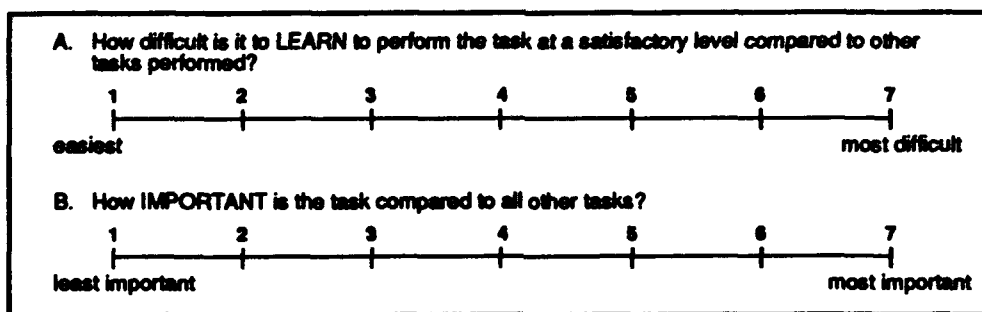


Figure 5. Seven-point Likert scales used in the task analysis.

Survey data were entered into statistical programs at the offices of Anacapa Sciences, Inc., Santa Barbara, CA. For each crew position, calculations were performed to obtain the mean difficulty to learn and the mean importance scores for each task statement. Mean difficulty to learn and mean importance scores were then combined to provide a measure of overall task criticality.

Ability Ranking

LCAC crew personnel were also asked to complete a simple card-sort exercise regarding the skills and abilities that they consider to be important to the performance of their jobs. Each crew member was given a "deck" of 24 ability cards (actually small square sheets of paper on which abilities and brief definitions were printed); most of the abilities were derived from Fleishman and Quaintance (1984).

The subjects were asked to place each of the ability cards under one of three category cards (i.e., More Important, Important, and Less Important) corresponding to the importance of that ability to the successful performance of the crew member's job.

The subjects then ranked the abilities *within* each category and reassembled the decks with the abilities in descending order of importance and the category cards in place. Each deck was fastened with a clip to preserve the relative order of the task and category cards according to each crew member. An example of the materials used in the card-sort exercise are presented as Appendix 4.

Card-sort data were hand-tabulated by recording the rank order of each ability card in each compiled deck of ability cards. It was then possible to calculate the mean ranking of the abilities for each crew position; the mean positions of the three category cards were also calculated. The results of the card-sort exercise are (five) lists of the abilities required for successful LCAC job performance of each LCAC crew position; the abilities are arranged in descending order of importance.

Summary

The task ranking and the ability ranking are separate components of the analytical process leading to an understanding of the work performed by LCAC crew. In particular,

- The results of the *ability ranking* provide information about the personal skills and abilities that are required for successful performance in the five LCAC crew positions. The ability analysis also identifies the skills and abilities that are less relevant to successful job performance.
- The results of the *task ranking* permit the researchers to identify what specific tasks and categories of tasks are most difficult to learn how to perform, what tasks are the most important to mission success, and what tasks are the most critical overall (i.e., by equally weighting difficulty to learn and task importance to obtain overall criticality).
- When reviewed together, the results of the ability and task rankings provide the researchers with a firm understanding of the personal skills and abilities that are the most important to successful job performance *and* specific examples of the tasks involving those skills and abilities. At this point, the analytical process becomes rational rather than statistical. An analyst can focus on the most important abilities and link them to specific examples of the most critical tasks. The linking of abilities to tasks is also a means to check for internal validity; *the most critical tasks should clearly involve the most important abilities.*

RESULTS OF THE TASK ANALYSIS

A total of 126 LCAC crew personnel completed the task analysis survey. Table 20 presents the number of participating personnel in each position from the two ACUs; also included in the table is the average LCAC experience, in years, for each crew position.

TABLE 20
NUMBERS AND EXPERIENCE OF PARTICIPATING LCAC CREW PERSONNEL

Crew Position	ACU-4	ACU-5	Totals	Average Yrs Experience	Range
Craftmaster	9	13	= 22	2.2	.5-6 yrs
Engineer	11	11	= 22	1.5	.5-5 yrs
Navigator	11	16	= 27	2.2	.5-7 yrs
Loadmaster	13	12	= 25	1.7	.5-6 yrs
Deck Mechanic	11	19	= 30	2.0	.5-4 yrs
Totals	55	71	= 126		

Task statements were presented in the questionnaires divided into 14 categories, based on the functional similarity of the tasks. The number of tasks in each category, and the total number of tasks, varied with the crew position. The 14 categories of LCAC crew tasks are listed below.

- A. Mission Planning Procedures
- B. Pre- and Post-Mission Checklist Procedures (inspections)
- C. Basic Craft Checklist Procedures (power up and down, come off cushion)
- D. Thrumission Checklist Procedures (inspections)
- E. Mooring and Anchoring Procedures
- F. Maneuvering Procedures
- G. Over Land Maneuvering Procedures
- H. Communications Tasks
- I. General Procedures (decision-making, coordination, operating equipment)
- J. Administrative Tasks (records, reports)
- K. Casualty Control Procedures (craft underway)
- L. Emergency Procedures
- M. Special Operations Procedures
- N. Fueling Procedures
- O. Maintenance Procedures (supervision by craftmaster only, not PMS tasks)

Results of the task analysis are presented below for each crew position, referring to the 14 categories of tasks and the skills and abilities considered to be most important to the performance of that crew position's duties.

The mean difficulty-to-learn score of a task has been combined with that task's mean-importance score, resulting in a combined score that has been defined as the task's overall criticality score. A criticality score was calculated for each task performed by a crew position. For example, the Craftmaster task *Perform well deck entry with support ship at anchor* received a mean difficulty to learn score of 4.83 (the second highest Craftmaster difficulty score) and an importance score of 6.87 (the eighth highest importance score). Combining these two scores results in a composite score of 11.70, which is the highest composite score--the number one Craftmaster task in terms of overall criticality. Calculation of composite scores gives equal weight to crew estimates of difficulty to learn and task importance. Although difficulty to learn and importance will be addressed, the focus of the following discussions of each crew position will be on the overall criticality of tasks.

Craftmaster

Craftmasters are responsible for performing (i.e., knowing how to perform) approximately 190 operational tasks, from the relatively simple inspection of the port passenger compartment to the highly technical performance of a well deck entry. Appendix 5 presents three complete inventories of Craftmaster tasks listed in descending order of 1) overall criticality, 2) difficulty to learn, and 3) importance.

The Craftmaster's primary responsibility is to operate the LCAC, controlling his craft's velocity and direction between an amphibious assault ship and the assigned destination ashore. Accordingly, eight of the top ten Craftmaster tasks, in terms of overall criticality, are maneuver tasks; the remaining two tasks are performed in response to emergencies. Furthermore, 11 additional maneuver tasks appear in the top 25 percent of all Craftmaster tasks (e.g., turning under way, backing down a slope, lateral translation, etc.).

Table 21 presents the top ten Craftmaster tasks in descending order of overall criticality (from Appendix 5). Also included in the table are the mean values obtained from the task analysis survey for overall criticality, difficulty to learn, and task impor-

tance; the rank order of the tasks in terms of difficulty to learn and task importance are provided in parentheses following the corresponding mean score on the seven-point scales. (Note that the overall criticality value is the sum of the other two values; and, the *higher* the value, the more critical, difficult to learn, or important is the task.)

TABLE 21
MOST CRITICAL CRAFTMASTER TASKS

Task	Overall Criticality	Difficulty to Learn	Importance
1. Perform well deck entry with support ship at anchor.	11.70	4.83 (2)	6.87 (8)
2. Perform well deck entry with support ship underway.	11.56	4.65 (4)	6.91 (6)
3. Operate craft in high winds over land in daylight.	11.56	4.78 (3)	6.78 (11)
4. Operate craft in heavy weather, in daylight, over water with sea state of 4 or greater.	11.53	4.86 (1)	6.67 (19)
5. Traverse slopes (small hills and sand dunes), craft in maneuvering mode.	11.35	4.65 (5)	6.70 (17)
6. Operate craft at night, using night vision equipment.	11.05	4.55 (7)	6.50 (38)
7. Translate land-to-water into 4-8 feet of surf.	11.04	4.48 (8)	6.56 (26)
8. Perform low speed water-to-land transition in smooth water and obstacles on beach.	11.04	4.30 (9)	6.74 (14)
9. Respond and direct crew response to general craft fire.	10.82	3.82 (26)	7.00 (2)
10. Tow another craft.	10.80	4.65 (6)	6.15 (105)

Numbers in parentheses indicate rank order of task in terms of that dimension.

Clearly, the most critical tasks performed by craftmasters are those that involve controlling the speed and direction of the vessel when in proximity to objects such as the support ship and beach hazards (slopes, sand dunes, and obstacles). The task analysis indicates that craftmasters consider well deck entries and operating LCACs in heavy weather to be among the most difficult tasks to learn how to perform and among the most critical tasks overall. But what are the skills and abilities that are important to performing those tasks and other Craftmaster responsibilities?

Table 22 presents the results of the craftmasters' ability ranking exercise. The table indicates that craftmasters consider *reaction time* to be the most important ability to the successful performance of their job. Craftmasters share this emphasis on quick response with aviators who, for the same reasons as LCAC craftmasters, must react quickly to avoid obstacles when navigating at low altitudes and high speeds. The importance of quick reactions by aviators and craftmasters is compounded by the response lag of the operators' controls; that is, a precise control change (input) must be made

several seconds before the aerodynamic forces result in the desired direction or speed change.

TABLE 22
CRAFTMASTER ABILITY RANKING
(23 Craftmasters from ACU 4 and 5)

RANK ORDER	ABILITY	MEAN SCORE
More Important Abilities		
1.	Reaction time	7.65
2.	Depth perception	9.35
3.	Spatial orientation	9.48
4.	Teamwork	10.17
5.	Night vision	10.35
6.	Problem-solving	10.96
7.	Oral expression	11.26
8.	Near vision	12.35
9.	Assertiveness	12.39
10.	Far vision	12.52
11.	Oral comprehension	13.13
12.	Memorization	13.22
13.	Manual dexterity	13.35
14.	Control precision	14.09
15.	Peripheral vision	14.30
16.	Color discrimination	14.43
17.	Stamina	14.78
18.	Arm-hand steadiness	15.52
19.	Speed of limb movement	15.52
Important Abilities		
20.	Finger dexterity	19.48
21.	Math reasoning	19.65
22.	Written comprehension	21.22
23.	Written expression	21.57
24.	Strength	22.65
Less Important Abilities		
None in this category		
The <i>lower</i> the mean score, the higher the ranking of an ability.		

Good *depth perception* and *spatial orientation* abilities were rated as the second and third most important Craftmaster abilities necessary to successfully operate an LCAC. The Craftmaster must be able to accurately distinguish which objects are closer and more distant and to estimate the distances to objects--an ability essential to well deck entries and beach approaches. Similarly, *spatial orientation* is necessary to maintain a mental picture of the vessel's surroundings when those surroundings are changing rapidly due to the vessel's high speed, changing course, and the presence of support vessels and other LCACs that are also maneuvering. Exceptional craftmasters

develop a "situational awareness" that permits them to maneuver, even among maneuvering vessels, yet retain their spatial orientation.

Teamwork, night vision, problem solving, and oral expression are the fourth through the seventh most important Craftmaster abilities, based on the estimates of our sample of craftmasters. While these abilities seem very different they are linked functionally by the process that occurs on the flight deck of an LCAC when attempting to perform the craft's most likely mission, a high speed beach approach at night. It was mentioned earlier that LCAC crew experience difficulties in making nighttime beach approaches even when operating in a familiar area. Night vision is degraded by sea spray and the constant action of the wipers, which requires that beach approaches be performed as a team effort. All three members of the flight deck crew and the Loadmaster in his cupola strain to identify lights and other shore features that can be used as references when navigating inshore. During beach approaches the intra-crew communications assume the form of group problem-solving with the Navigator's face buried in his radar display as he calls out closing distances, the Engineer searching for lights and features and making quick scrolls through his dozen or more engineering displays, and the Loadmaster searching for surface contacts and indications of the correct landing area. The process is led by the Craftmaster who, like the captain or coach of a basketball team, frequently requests information from specific crewmen, assimilates the information, and makes decisions and control changes based on the information that he obtains from his crew and through his own visual abilities. In this regard, it is important to note that craftmasters considered teamwork to be more important to the performance of their job than even near vision, far vision, peripheral vision, and color discrimination.

Engineer

LCAC engineers are responsible for performing (i.e., knowing how to perform) approximately 195 operational tasks, the greatest number of tasks for which any of the five crew positions is responsible. This is because the Engineer is also the Assistant Craftmaster; that is, engineers must know how to operate the LCAC in addition to performing their many engineering duties. Appendix 6 presents three complete inventories of engineer tasks listed in descending order of 1) overall criticality, 2) difficulty to learn, and 3) importance.

The Engineer's primary responsibilities are to monitor and maintain the smooth functioning of all mechanical systems aboard the LCAC, and to diagnose problems and make repairs when necessary. It must be understood that an LCAC is an extremely sophisticated vessel, with power plants and other complex equipment similar to that found aboard high-performance aircraft. Accordingly, the task considered to be the most difficult to learn for LCAC engineers is *Diagnose equipment problems, faults, or casualties*. Further, 31 troubleshooting and repair tasks (i.e., respond and restore actions) appear in the top 25 percent of all Engineer tasks in terms of overall criticality.

Table 23 presents the top ten LCAC Engineer tasks in descending order of overall criticality (from Appendix 6). Also included in the table are the mean values obtained from the task analysis survey for overall criticality, difficulty to learn, and task importance; the rank order of the tasks in terms of difficulty to learn and task importance are provided in parentheses following the corresponding mean score on the seven-point scales.

TABLE 23
MOST CRITICAL ENGINEER TASKS

Task	Overall Criticality	Difficulty to Learn	Importance
1. Respond to general craft fire.	11.38	4.38 (2)	7.00 (1)
2. Diagnose equipment problems, faults, or casualties.	11.36	4.50 (1)	6.86 (6)
3. Respond to a craft deck cargo fire.	11.32	4.37 (3)	6.95 (2)
4. Respond to audible alarm and fire lights for main engine compartment.	10.91	4.00 (5)	6.91 (3)
5. Respond to fire in fuel bay.	10.85	3.95 (9)	6.90 (5)
6. Respond to collision.	10.81	3.95 (8)	6.86 (7)
7. Respond to audible alarm and fire lights for APU compartment.	10.80	3.90 (10)	6.90 (4)
8. Make engineering decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.	10.77	4.14 (4)	6.63 (15)
9. Abandon craft, craft sinking or fire out of control.	10.70	3.90 (11)	6.80 (9)
10. Respond to loss of main engine.	10.50	3.68 (14)	6.82 (8)
Numbers in parentheses indicate rank order of task of that dimension.			

In addition to determining the causes of faults and equipment casualties, the most critical tasks performed by engineers are responses to major problems or emergencies; it is obvious from the list that fire is the most serious problem that can be confronted aboard an LCAC from the Engineer's perspective. Results of the task analysis indicate that engineers consider casualty control procedures (in particular, diagnosing equipment faults) and responding to serious emergencies (fire, collision, loss of power) to be among the most difficult tasks to learn how to perform and among the most critical tasks overall. Also among the most critical engineer tasks, but not among the top ten, are those control adjustments and other actions performed by the Engineer in support of the Craftmaster's transition from hullborne to cruise mode, and the LCAC's well deck and beach approaches.

Table 24 presents the results of the Engineers' evaluation of the abilities that are most important to the successful performance of their job. It is not surprising that *problem solving* is considered to be the most important ability to LCAC engineers because it is those crewmen who are responsible for solving the continuous stream of small and large equipment problems that occur in the many complex systems that provide the LCAC with its unique capabilities. Fault isolation, troubleshooting, casualty control--*problem solving*--are the routine activities of LCAC engineers. Those engineers who excel at problem solving provide considerable advantage to their vessels.

Assertiveness and *teamwork* are the second and third most important abilities, according to the LCAC engineers who participated in the task analysis survey. Both of these abilities were adapted to the LCAC ability list from the field of cockpit resource management (i.e., the study of communication, coordination, and cooperation among aircraft crew). Assertiveness refers to the ability of a crew member to bring information (usually a problem) to the attention of another crew member (usually the crewman in charge). Individual rank, experience, and personality factors can create a situation in which crew personnel hesitate or are reluctant to inform an operator about a condition or problem; aboard LCACs, as in military and commercial aviation, a lack of assertiveness can result in disaster.

Similarly, the high placement of *teamwork* on the engineers' ability list confirms our earlier observations regarding the importance of this ability (or skill) to LCAC operations. The Engineer, in particular, is sensitive to the importance of teamwork because he sits between the Navigator and the Craftmaster providing and receiving information

from both positions and supporting their actions with engineering data and cushion vane and speed adjustments. The Engineer also directs the actions of the deck mechanic and loadmaster when they are assisting the engineer with troubleshooting tasks. During casualty control and troubleshooting procedures the Engineer usually remains at his console on the flight deck while the deck mechanic and loadmaster serve as his eyes and hands at the equipment in question. Fluid exchange of information and cooperation--*teamwork*--are essential to this process.

TABLE 24
ENGINEER ABILITY RANKING
(22 Engineers from ACU 4 and 5)

RANK ORDER	ABILITY	MEAN SCORE
More Important Abilities		
1.	Problem solving	6.59
2.	Assertiveness	8.55
3.	Teamwork	8.82
4.	Night vision	9.55
5.	Reaction time	9.73
6.	Oral comprehension	10.50
7.	Memorization	10.86
8.	Finger dexterity	11.50
9.	Oral expression	12.00
Important Abilities		
10.	Control precision	12.36
11.	Far vision	12.68
12.	Depth perception	13.32
13.	Peripheral vision	14.00
14.	Arm-hand steadiness	14.45
15.	Near vision	14.55
16.	Spatial orientation	15.05
17.	Color discrimination	15.59
18.	Written expression	17.14
19.	Manual dexterity	17.32
20.	Written comprehension	17.32
21.	Stamina	18.81
22.	Math reasoning	19.09
23.	Speed of limb movement	20.05
Less Important Abilities		
24.	Strength	23.86
The lower the mean score, the higher the ranking of an ability.		

Engineers also consider *night vision, reaction time, memorization, oral comprehension and oral expression* among the most important abilities to the successful

performance of their work. *Night vision* is important because the Engineer searches the coastline for lights and features along with the Navigator, Loadmaster, and Craftmaster (and he must replace the Craftmaster as operator, if necessary). *Reaction time* is important for the same reasons this ability is considered by craftmasters to be the most important ability of them all; that is, when operating as Craftmaster, an Engineer must respond quickly to visual stimuli and changing conditions. In addition, the Engineer must respond quickly to equipment casualties. *Oral comprehension and expression* are important because so much of the Engineer's job involves communicating with other crew, usually through the onboard communications network, to receive or provide information or to direct restoration or maintenance actions. Finally, *memorization* is important to LCAC engineers because they must remember the appropriate or nominal parameters for each of the 15 engineering screens that they routinely call up on their engineering display. And, engineers must recall the appropriate responses to possible emergencies and the many equipment faults and casualties for which they are responsible.

Navigator

LCAC navigators are responsible for performing (i.e., knowing how to perform) approximately 121 operational tasks, ranging from simply obtaining the outside temperature from the Engineer to correctly activating the global positioning system (GPS), a sophisticated navigation instrument. Appendix 7 presents three complete inventories of Navigator tasks listed in descending order of 1) overall criticality, 2) difficulty to learn, and 3) importance.

The Navigator's primary responsibilities are to develop the mission plan, plot courses to and from an objective, then operate the navigation equipment and provide course correction and surface contact information to the Craftmaster enroute. The Navigator is also responsible for most of the crew's record-keeping tasks, and he serves as the safety officer on deck during mooring and departure maneuvers. Clearly, a Navigator's many responsibilities, both afloat and ashore, make him a very busy member of an LCAC crew.

Navigators rated the task *Activate the global positioning system* to be the most difficult task to learn how to perform correctly, followed closely by *Performing navigation duties at night*. The latter statement is not really a task but an environmental condition;

statements like these were included in the task inventories to gauge the roles played by environmental conditions (i.e., low light, nighttime, high winds and sea states) in difficulty to learn and task criticality. Nearly half of the top 25 percent of the most critical Navigator tasks involve navigation activities (e.g., develop mission plan, plot a course using dead reckoning, read nautical charts, operate radars and radios, etc.). The remainder of the top 25 percent of Navigator tasks are primarily emergency and safety-related actions.

Table 25 presents the top ten LCAC Navigator tasks in descending order of overall criticality (from Appendix 7). Also included in the table are the mean values obtained from the task analysis survey for overall criticality, difficulty to learn, and task importance; the rank order of the tasks in terms of difficulty to learn and task importance are provided in parentheses following the corresponding mean score on the seven-point scales. The top ten tasks provide clear examples of the Navigators' divided concerns among navigation, problem solving, and safety responsibilities.

TABLE 25
MOST CRITICAL NAVIGATOR TASKS

Task	Overall Criticality	Difficulty to Learn	Importance
1. Perform navigator duties in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.	10.80	4.07 (4)	6.73 (6)
2. Activate the global positioning system (GPS).	10.77	4.35 (1)	6.42 (15)
3. Perform navigator duties at night, using night vision equipment.	10.64	4.12 (2)	6.52 (7)
4. Make navigation decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.	10.59	4.11 (3)	6.48 (11)
5. Serve as safety officer on deck to assist anchoring craft.	10.32	3.82 (13)	6.50 (10)
6. Serve as safety officer on deck to assist mooring to a ship at anchor.	10.31	3.81 (14)	6.50 (9)
7. Respond to collision.	10.20	3.44 (27)	6.76 (4)
8. Serve as safety officer on deck to assist departure from ship mooring.	10.19	3.94 (5)	6.25 (25)
9. Serve as safety officer on deck to assist mooring to a pier.	10.14	3.73 (16)	6.40 (16)
10. Develop mission plan, using appropriate formulas and collected information, and present plan to craftmaster for review.	10.13	3.85 (11)	6.28 (22)

Numbers in parentheses indicate rank order of task in terms of that dimension.

Table 26 presents the results of the Navigators' evaluation of the abilities that are most important to the successful performance of their job. All of the most important abilities are related to the Navigators' primary responsibility of directing the Craftmaster to the intended objective.

TABLE 26
NAVIGATOR ABILITY RANKING
(25 Navigators from ACU 4 and 5)

RANK ORDER	ABILITY	MEAN SCORE
More Important Abilities		
1.	Night vision	8.12
2.	Color discrimination	8.76
3.	Problem-solving	9.28
4.	Teamwork	9.56
5.	Oral expression	9.76
6.	Spatial orientation	9.76
7.	Assertiveness	10.08
8.	Memorization	10.64
9.	Oral comprehension	11.20
10.	Reaction time	12.48
11.	Far vision	12.52
12.	Near vision	12.56
13.	Depth perception	13.64
Important Abilities		
14.	Math reasoning	14.08
15.	Stamina	14.24
16.	Written comprehension	14.40
17.	Control precision	16.24
18.	Finger dexterity	17.12
19.	Written expression	17.76
20.	Peripheral vision	17.84
21.	Manual dexterity	18.36
22.	Speed of limb movement	21.69
23.	Arm-hand steadiness	22.24
Less Important Abilities		
24.	Strength	24.24
The lower the mean score, the higher the ranking of an ability.		

For example, *night vision* and *color discrimination* are considered to be the two most important Navigator abilities. Despite the availability of sophisticated navigation aids, like radar and the GPS, navigators still must rely on visual acquisition and identification of obstacles, lights, and other shore-side features to provide guidance to the Craftmaster. Good *night vision* abilities are essential because LCAC missions are

conducted in low light and at night; good *color discrimination* is required to facilitate the identification of features in order that the LCAC is directed toward the correct beach when marked by lights or when using lights as navigational references. Similarly, *spatial orientation, far vision, near vision, and depth perception* are among the most important abilities to navigators because they help them solve navigation problems.

Problem solving, teamwork, and oral expression are important to navigators for the same reasons they are important to engineers and craftmasters; that is, operating an LCAC is a cooperative effort and much of that effort is directed toward solving what are essentially navigation problems. Especially during beach approaches the information exchange among crew is almost exclusively directed toward answering the questions: Where are we supposed to go and is anything in our way? The skills and abilities that permit answering these questions (at night and with visibility degraded by sea spray) are essential to the successful performance of LCAC Navigator duties.

Loadmaster

LCAC loadmasters are responsible for performing (i.e., knowing how to perform) 137 operational tasks, ranging from the performance of simple visual inspections to the operation of mission-critical equipment. Appendix 8 presents three complete inventories of Loadmaster tasks listed in descending order of 1) overall criticality, 2) difficulty to learn, and 3) importance.

The Loadmaster's primary responsibilities are to develop the LCAC load plan by calculating the weights and centers of gravity of scheduled cargo, then to determine the most appropriate placement of each item on deck; the Loadmaster is also responsible for securing cargo to the deck of the LCAC and for supervising Marines and other crew when they assist with the cargo. The Loadmaster also has important responsibilities on deck in the event of equipment casualties and emergencies. Finally, the activity that consumes most of a Loadmaster's operational time is providing lookout duties while the LCAC is under way. In this regard, the Loadmaster serves as the Craftmaster's eyes for all observations made to port, and as an additional set of eyes when the crew is searching for surface contacts and surf or beach features ahead.

Loadmasters rated the tasks *Calculate cargo weights using appropriate formulas* and *Operate the P-250 pump* to be the most difficult tasks to learn how to perform

correctly (the tasks both received means of 4.0 on the seven-point difficulty to learn scale), followed closely by *Rig the P-250 pump*. Further, nearly half of the top 25 percent of the most critical Loadmaster tasks are activities involving the deck cargo or rigging (e.g., determine optimum layout for balancing cargo, respond to loose cargo on deck, rig and deploy anchor, tow rig, etc.). The remainder of the top 25 percent of the Loadmasters' most critical tasks are lookout and emergency-related actions.

Table 27 presents the top ten LCAC loadmaster tasks in descending order of overall criticality (from Appendix 8). Also included in the table are the mean values obtained from the task analysis survey for overall criticality, difficulty to learn, and task importance; the rank order of the tasks in terms of difficulty to learn and task importance are provided in parentheses following the corresponding mean score on the seven-point scales. The top ten tasks provide clear examples of the Loadmaster's range of operational responsibilities.

TABLE 27
MOST CRITICAL LOADMASTER TASKS

Task	Overall Criticality	Difficulty to Learn	Importance
1. Operate the P-250 pump.	10.73	4.00 (2)	6.73 (12)
2. Rig the P-250 pump.	10.48	3.90 (3)	6.58 (24)
3. Calculate cargo weight using appropriate formula.	10.16	4.00 (1)	6.16 (74)
4. Perform loadmaster duties in heavy weather, over water, in daylight, with sea state of 4 or greater.	10.09	3.39 (8)	6.70 (16)
5. Abandon craft, craft sinking or fire out of control.	9.84	2.84 (23)	7.00 (2)
6. Respond to failed tow rig.	9.81	2.86 (22)	6.95 (4)
7. Respond to man overboard.	9.74	2.84 (24)	6.90 (5)
8. Perform loadmaster duties in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.	9.61	2.83 (27)	6.78 (11)
9. Respond to a craft deck cargo fire.	9.60	2.60 (43)	7.00 (1)
10. Rig the craft tow rig to tow an LCAC.	9.56	2.83 (26)	6.73 (10)

Numbers in parentheses indicate rank order of task in terms of that dimension.

Table 28 presents the results of the Loadmasters' evaluation of the abilities that are the most important to the successful performance of their job. All of the most important abilities are related to the Loadmaster's lookout, rigging, cargo, and emergency response functions.

TABLE 28
LOADMASTER ABILITY RANKING
(25 Loadmasters from ACU 4 and 5)

RANK ORDER	ABILITY	MEAN SCORE
More Important Abilities		
1.	Night vision	6.27
2.	Teamwork	9.55
3.	Depth perception	9.90
4.	Spatial orientation	10.14
5.	Problem-solving	11.14
6.	Far vision	11.23
7.	Peripheral vision	11.36
8.	Assertiveness	11.55
9.	Oral expression	11.86
10.	Near vision	11.91
11.	Reaction time	12.32
12.	Color discrimination	12.45
13.	Oral comprehension	12.55
Important Abilities		
14.	Memorization	14.05
15.	Stamina	14.36
16.	Math reasoning	15.95
17.	Strength	16.23
18.	Manual dexterity	17.18
19.	Speed of limb movement	19.23
20.	Arm-hand steadiness	19.82
21.	Control precision	19.82
22.	Written comprehension	20.05
23.	Finger dexterity	20.32
24.	Written expression	20.68
Less Important Abilities		
None in this category		
The lower the mean score, the higher the ranking of an ability.		

Night vision was rated by loadmasters to be the most important ability to the successful performance of the job; the ability received the lowest mean score (i.e., the highest importance ranking) of any ability rated by the five LCAC crew positions--and more than three points lower than the second most important ability to loadmasters. The extraordinarily high emphasis placed on night vision by loadmasters reflects the importance of the Loadmaster's lookout responsibilities while the craft is under way. In fact, all of the most important Loadmaster abilities (those ranked 1 through 13) are related to the Loadmaster's performance as the port lookout. *Night vision, depth perception, spatial orientation, far vision, peripheral vision*--even *near vision*--are all involved in performing lookout duties.

It is important to note that the Loadmaster assists the flight deck crew with observations ahead, but he is solely responsible for providing the flight deck crew with information about contacts and clearances to port. Four crewmen can work together to make accurate observations ahead of the vessel, and the Craftmaster and Engineer can see to starboard; the Loadmaster, however, is totally responsible for all observations to port. In other words, there is no sharing of responsibility for failing to observe or report an obstacle on the port side of the LCAC; all port-side lookout errors belong to the Loadmaster alone, hence the importance placed on visual abilities by loadmasters. The emphasis on lookout responsibilities also explains the relatively high emphasis placed on *teamwork, assertiveness, problem solving*, and the two communication abilities. Teamwork and problem solving are also essential Loadmaster abilities when working with the Engineer to diagnose and repair faults, when responding to emergencies, and when securing cargo and performing line-handling duties.

Deck Mechanic

LCAC Deck Mechanics are responsible for performing (i.e., knowing how to perform) 113 operational tasks, ranging from the relatively simple task of refilling the distilled water tank to troubleshooting complex equipment faults and casualties, either independently or in cooperation with the Engineer. Appendix 9 presents three complete inventories of Loadmaster tasks listed in descending order of 1) overall criticality, 2) difficulty to learn, and 3) importance.

The Deck Mechanic's primary responsibilities are to help diagnose the causes of equipment problems and to assist the Engineer in his restoration efforts. The Deck Mechanic is also responsible for post-flight water wash-down of the LCAC and its machinery (a task that occupies the Deck Mechanic and other crew members for hours following each flight), and he serves as a line handler during docking and anchoring maneuvers. Finally, the Deck Mechanic serves as the LCAC's alternate port-side lookout, providing occasional relief to the Loadmaster.

Deck mechanics rated the task *Diagnose equipment problems, faults, and casualties* as the most difficult task to learn how to perform correctly, followed closely by three tasks in which the Deck Mechanic provides assistance to the Engineer in recovering from serious equipment problems (loss of lift, loss of rudder control, and loss of bow thruster control). Further, all but five of the top 25 percent of the most critical deck

mechanic tasks are troubleshooting and restoration activities, most of them performed in cooperation with the LCAC Engineer. The remainder of the top 25 percent of the Deck Mechanic's most critical tasks are relief-lookout and emergency-related actions.

Table 29 presents the top ten LCAC Deck Mechanic tasks in descending order of overall criticality (from Appendix 9). Also included in the table are the mean values obtained from the task analysis survey for overall criticality, difficulty to learn, and task importance; the rank order of the tasks in terms of difficulty to learn and task importance are provided in parentheses following the corresponding mean score on the seven-point scales. As is the case with all five LCAC crew positions, the top ten tasks provide excellent examples of the Deck Mechanic's range of operational duties.

TABLE 29
MOST CRITICAL DECK MECHANIC TASKS

Task	Overall Criticality	Difficulty to Learn	Importance
1. Diagnose equipment problems, faults, and casualties.	11.00	4.39 (1)	6.61 (3)
2. Assist the engineer in recovering from loss of lift.	10.48	4.00 (2)	6.48 (15)
3. Assist the engineer in recovering from loss of rudder control either hydraulic or electrical problem.	10.36	3.97 (3)	6.39 (22)
4. Assist the engineer in recovering from loss of bow thruster control.	10.16	3.68 (4)	6.48 (14)
5. Assist the engineer in recovering from loss of main engine fuel pressure.	10.07	3.52 (10)	6.55 (6)
6. Assist the engineer in recovering from loss of main engine.	9.94	3.48 (13)	6.45 (19)
7. Make decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.	9.90	3.61 (7)	6.29 (33)
8. Perform port side lookout duties, in relief of loadmaster, as necessary (over water).	9.83	3.66 (5)	6.17 (44)
9. Request and receive information from engineer regarding power plant or other engineering issues.	9.81	3.13 (42)	6.68 (1)
10. Assist the engineer in recovering from main engine low lube oil pressure.	9.80	3.32 (22)	6.48 (13)

Numbers in parentheses indicate rank order of task in terms of that dimension.

Table 30 presents the results of the Deck Mechanics' evaluation of the abilities that are the most important to the successful performance of their job. Six of the seven most important abilities are related to the Deck Mechanic's troubleshooting functions, and one ability is clearly linked to the Deck Mechanic's role as the relief port-side look-out for the craft.

TABLE 30
DECK MECHANIC ABILITY RANKING
(32 Deck Engineers from ACU 4 and 5)

RANK ORDER	ABILITY	MEAN SCORE
More Important Abilities		
1.	Teamwork	6.69
2.	Reaction time	9.72
3.	Assertiveness	10.72
4.	Oral comprehension	10.75
5.	Night vision	10.78
6.	Problem-solving	10.81
7.	Oral expression	10.91
Important Abilities		
8.	Memorization	12.34
9.	Stamina	13.16
10.	Near vision	13.47
11.	Peripheral vision	13.97
12.	Depth perception	14.16
13.	Manual dexterity	14.31
14.	Far vision	14.78
15.	Spatial orientation	15.03
16.	Control precision	15.63
17.	Strength	16.69
18.	Color discrimination	16.97
19.	Written comprehension	17.22
20.	Arm-hand steadiness	18.56
21.	Written expression	18.66
22.	Speed of limb movement	19.47
23.	Finger dexterity	20.25
24.	Math reasoning	21.59
Less Important Abilities		
None in this category		
The lower the mean score, the higher the ranking of an ability.		

By a wide margin *teamwork* was rated by deck mechanics to be the most important ability to the performance of their job. No other crew position rated teamwork as high as did deck mechanics, but no other crew position is so clearly a member of the team. That is, while the other crew positions have specific responsibilities for which they have the lead, the Deck Mechanic's primary responsibility is to work with, and at

the direction of, the LCAC Engineer in the maintenance and restoration of equipment. A good Deck Mechanic possesses sufficient technical knowledge and ability to provide the Engineer with detailed information about the status of a problem and to anticipate the Engineer's direction--anticipation of needs (providing necessary information, or making way to a location before it is requested) is the hallmark of teamwork. A Deck Mechanic provides the Engineer with eyes, ears, and hands at the equipment, permitting the Engineer to remain on the flight deck to make control changes and monitor the system status displays. Deck mechanics that combine technical knowledge with the ability to work well with their colleagues are extremely valuable crew members.

Deck mechanics also rated *reaction time* as one of the most important abilities to the performance of their work. It is believed that reaction time is highly rated due to the need for quick responses to many possible engineering emergencies aboard an LCAC. Similarly, *assertiveness, problem solving, and oral comprehension and expression* are valued by deck mechanics for the importance of those abilities when responding as a team to equipment faults and casualties. Troubleshooting is definitely a problem solving activity, and aboard LCACs, nearly all problems are solved through teamwork.

Night vision ability is clearly related to the Deck Mechanic's role as the relief port-side lookout. (Recall that loadmasters, the primary port-side lookouts, rated night vision as the most important ability to the successful performance of their job.)

DISCUSSION AND CONCLUSIONS

Systematic analysis of the work performed by the five LCAC crew positions has led to the identification of the operational tasks that are the most difficult to learn and the most important to mission success. Difficulty to learn and importance scores were combined to obtain composite scores that reflect overall task criticality.

Appendices 5 through 9 provide lists of the LCAC crew tasks arranged in descending order of their scores on the difficulty to learn, importance, and overall criticality scales. We have used these lists, in particular those lists presenting the tasks in order of overall criticality, to help identify and explain the personal abilities that contribute to successful performance in the five LCAC crew positions.

The results of the task and ability analysis are available to support other objectives, as well. For example, trainers and curriculum developers for the LCAC may find it useful to compare the difficulty to learn and overall criticality task lists to current and

planned LCAC course material and schedules. In this way analysts can ensure that the training effort devoted to a task (or task category) is commensurate with the task's relative difficulty to learn or criticality. It will be possible to easily determine if a disproportionate amount of training effort is spent on relatively easy or non-critical tasks. Similarly, tasks that are not sufficiently addressed in training might also be identified. In this way, trainers and curriculum developers can use the results of these analyses to guide the development or realignment of training curricula, thereby enhancing training and operational effectiveness.

The ultimate purpose of the LCAC task analysis, however, is to provide the developers of LCAC medical standards with valid information concerning the individual abilities required for successful task performance in the five LCAC crew positions. The most important abilities associated with each LCAC crew position have been discussed in the previous paragraphs. Table 31 provides a summary of those abilities; the abilities listed in Table 31 represent the top 25 percent of the abilities included in the analysis (i.e., the top six of the 24 abilities evaluated for each crew position).

TABLE 31
SUMMARY OF THE MOST IMPORTANT CREW ABILITIES

FLIGHT DECK CREW	PORT CABIN CREW
KEY CRAFTMASTER ABILITIES <ul style="list-style-type: none"> • Reaction time • Depth perception • Spatial orientation • Teamwork • Night vision • Problem solving 	KEY LOADMASTER ABILITIES <ul style="list-style-type: none"> • Night vision • Teamwork • Depth perception • Spatial orientation • Problem solving • Far vision
KEY ENGINEER ABILITIES <ul style="list-style-type: none"> • Problem solving • Assertiveness • Teamwork • Night vision • Reaction time • Oral comprehension 	KEY DECK MECHANIC ABILITIES <ul style="list-style-type: none"> • Teamwork • Reaction time • Assertiveness • Oral comprehension • Night vision • Problem solving
KEY NAVIGATOR ABILITIES <ul style="list-style-type: none"> • Night vision • Color discrimination • Problem solving • Teamwork • Oral expression • Spatial orientation 	

It is apparent from Table 31 that there is considerable commonality among the crew positions in the abilities that are considered to be most important to successful crew performance aboard an LCAC. Table 32 is provided to help identify those abilities that are common to flight deck crew (Craftmaster, Engineer, and Navigator), port cabin crew (Loadmaster and Deck Mechanic), and to the LCAC crew as a whole. Identifying abilities that are common to LCAC crew positions may assist in determining which abilities should be stressed in personnel selection and retention for duty standards.

In Table 32 we have assigned a star to each of the nine abilities that appeared in the previous table for each crew position. Each star represents an LCAC crew position that rated that ability within the top 25 percent of all abilities involved in the performance of LCAC tasks.

TABLE 32
KEY ABILITIES REQUIRED FOR
SUCCESSFUL PERFORMANCE OF LCAC CREW TASKS

KEY ABILITY	FLIGHT DECK CREW (3)	PORT CABIN CREW (2)	ENTIRE LCAC CREW (5)
Night vision *****	3	2	5
Problem solving *****	3	2	5
Teamwork *****	3	2	5
Reaction time ***	2	1	3
Spatial orientation ***	2	1	3
Assertiveness **	1	1	2
Depth perception **	1	1	2
Oral comprehension **	1	1	2
Oral expression *	1	0	1

Table 32 reveals that there are three abilities that are common to all five LCAC crew positions. Those "five star" abilities are *night vision*, *teamwork*, and *problem solving*. These are the abilities used by LCAC crew when making beach and well deck approaches and when solving navigation and engineering problems.

Table 32 also reveals two three-star abilities: *reaction time* and *spatial orientation*. Recall that quick reactions are valued by craftmasters in the operation of flight

controls, and by engineers and deck mechanics when responding to equipment problems and emergencies.

Table 32 indicates three two-star abilities: *depth perception*, *assertiveness*, and *oral comprehension*. Good *depth perception* was considered essential by craftmasters and loadmasters, the two crew positions with ultimate responsibility for ensuring the safe maneuvering of the LCAC, both at sea and during proximity operations (a term borrowed from NASA to describe maneuvers near obstacles and other vessels, for example, while maneuvering on a beach or during well deck entries). *Assertiveness* was rated high by engineers, who must bring problems to the attention of the Craftmaster, and by deck mechanics, who must bring problems to the attention of the Engineer and the Craftmaster--in a timely fashion. *Oral comprehension* was considered to be among the most important abilities to engineers and deck mechanics, the two crew positions that work closely together on the communications network during many mission critical procedures.

Oral expression is the only one-star ability. Navigators rated this ability among the most important to their job because most of their activity while under way involves the verbal presentation of navigation information to the Craftmaster. Navigators, more than any other crew members, must speak clearly and concisely to ensure that the Craftmaster understands the information that the Navigator provides.

RECOMMENDATIONS

- It is recommended that the LCAC personnel selection and retention for duty standards focus on the nine abilities presented in Table 32.
- It is recommended that cockpit resource management training be adapted from either naval or commercial aviation to enhance crew teamwork skills.
- It is recommended that night vision training be developed and provided to all LCAC crew personnel to enhance individual abilities and skilled performance.
- It is recommended that LCAC trainers and training developers review the results of the task analyses, in particular, Lists Number 2 in Appendices 5 through 9, to ensure that the tasks considered to be the most difficult to learn by LCAC crew are appropriately addressed in LCAC training courses.

PART II REFERENCES

Fleishman, E.A., & Quaintance, M.K. (1984). *Taxonomies of Human Performance: The description of Human Tasks*. New York: Academic Press, Inc.

Hart, S.G. (1988). Helicopter human factors. In E.L. Weiner and D.C. Nagel (eds.), *Human Factors in Aviation*. New York: Academic Press, Inc.

Holzer, R. (1992). Marines press to keep amphibious assault mission. *Defense News*, 7, 34, (August 24-30).

Kantowitz, B.H., & Casper, P.A. (1988). Human workload in aviation. In E.L. Weiner and D.C. Nagel (eds.), *Human Factors in Aviation*. New York: Academic Press, Inc.

McKearney, T.J. (1987, November). Launching the new assault wave. *Proceedings of the U.S. Naval Institute*, 113, 11.

Naval Health Research Center (NHRC), *Proceedings of the Landing Craft Air Cushion Crew Medical Standards Conference*, Jack W. Stuster (editor). Naval Health Research Center, Dan Diego, CA. 15-16 January 1991.

Stuster, J. (1991). Discussion of salient human factors issues associated with operation of the Landing Craft, Air Cushion. *Proceedings of the Landing Craft Air Cushion Crew Medical Standards Conference*, 15-16 January 1991.

APPENDIX 1.

**OUTLINE OF KEY TOPICS INCLUDED IN
PROPOSED REVISIONS FOR LANDING CRAFT,
AIR CUSHION (LCAC) CREW MEDICAL STANDARDS (PERMANENT)
(15 APR 92)**

**OUTLINE OF KEY TOPICS INCLUDED IN
PROPOSED REVISIONS FOR LANDING CRAFT,
AIR CUSHION (LCAC) CREW MEDICAL STANDARDS (PERMANENT)
(15 APR 92)**

- I. Medical Entrance Examination Requirements for Class I LCAC Crew Personnel**
- II. Medical Entrance Examination Requirements for Class IA (Minimum Distant Visual Acuity of 20/200 Correctable to 20/20 Each Eye).**
- III. Medical Entrance Examination Requirements for Class II Personnel**
- IV. Revision of Existing Physical Examination Standards**
- V. Revision of Existing Medical Guidelines in Current SEAOPS**
- VI. Revision of Allowable Drug List For LCAC Crew Personnel**
- VII. Development of Mandatory Requirements for LCAC Crew Members Who Have Been Medically Suspended From LCAC Duty**

APPENDIX 2.

**OUTLINE OF KEY TOPICS INCLUDED IN
(PROPOSED) LANDING CRAFT AIR CUSHION (LCAC) CREW
CANDIDATE MEDICAL ENTRANCE EXAMINATION STANDARDS (9 JUN 92)**

**OUTLINE OF KEY TOPICS INCLUDED IN
(PROPOSED) LANDING CRAFT AIR CUSHION (LCAC) CREW
CANDIDATE MEDICAL ENTRANCE EXAMINATION STANDARDS (9 JUN 92)**

- I. Medical Entrance Examination Requirements for LCAC Crew Selection
- II. Class I (Craftmaster, Engineer) LCAC Crew Candidate Physical Examination and Standards
- III. Class IA (Navigator) Candidate Physical Examination and Standards
- IV. Class II (Loadmaster, Deck Mechanic) Candidate Physical Examination and Standards
- V. Revision of Existing Medical Guidelines in Current Seaops
- VI. Revision of Allowable Drug List for LCAC Crew Personnel
- VII. Development of Mandatory Requirements for LCAC Crew Members Who Have Been Medically Suspended From LCAC Duty
- VIII. Revision of Existing Physical Examination Standards

APPENDIX 3.
LANDING CRAFT AIR CUSHION (LCAC)
CREW MEDICAL STANDARDS (CHANGE 107)

15-71A**Landing Craft
Air Cushion
(LCAC) Crew
Medical
Standards**

(1) **Purpose.** To select for LCAC crew duty only those individuals who are physically and mentally qualified for that duty and to exclude those who may become unfit because of preexisting physical or mental defect.

(2) **General.** LCAC crew personnel include all individuals who, in the performance of their duties, are required to make operational or training missions aboard LCAC or any other U.S. Navy air cushion vehicle. LCAC crew personnel are divided into three classes:

(a) **Class I.** Crew personnel engaged in the actual control of the LCAC, which includes the craft master and engineer, as well as the student craft master and the student engineer.

(b) **Class IA.** Crew personnel engaged in navigation of the LCAC, but not responsible for actual control of the craft, to include the navigator and student navigator.

(c) **Class II.** Crew personnel not engaged in the actual control of the LCAC, which includes load master, and deck mechanic, as well as student load master, and student deck mechanic.

(3) **Scope of Examination.** Class I and Class IA LCAC crew candidates must meet the standards in article 15-71A(5) and (6). Class II LCAC crew candidates must meet the standards in articles 15-71A (7). Conditions listed as disqualifying (see art. 15-71A(5), (6), and (7)) may be waived. However, additional medical tests, consultations, etc. are necessary in to confirm that no functional impairment is present or likely to occur (see art. 15-71A(9)).

(4) Examination Requirements

(a) **Class I (Craftmaster, Engineer) Candidates.** All Class I LCAC crew candidates will undergo an entrance physical examination at the designated LCAC medical examination center, the NAVAEROSPMEDINST (NAMI Code 26), before acceptance into Phase I of the LCAC training program. An SF-88 and SF-93 must be completed for all LCAC crew physical examinations. Class I candidates require psychomotor testing in addition to a physical examination. These psychomotor examinations will be performed in addition to the entrance physical examination at NAMI (Code 26). Candidates will be designated either:

- (1) Physically qualified (PQ).
- (2) Not physically qualified (NPQ).
- (3) NPQ but waiver recommended.

(b) **Class IA (Navigator) Candidates.** All Class IA LCAC crew candidates will undergo an entrance physical ex-

amination at a sufficiently equipped military medical facility before acceptance into Phase I of the LCAC training program. An SF-88 and SF-93 must be completed for all LCAC crew physical examinations. Candidates will be designated either:

- (1) Physically qualified (PQ).
- (2) Not physically qualified (NPQ).
- (3) NPQ but waiver recommended.

(c) **Class II (Loadmaster, Deck Mechanic) Candidates.** Candidates for Class II LCAC crew training must meet current medical standards for transfer and sea duty following the Enlisted Transfer Manual (ETM).

(5) Class I (Craftmaster, Engineer) LCAC Crew Candidate Physical Examination and Standards

(a) **General Examination.** Except as modified by this article, the basic physical examination and standards for acceptance as an LCAC crew candidate are the same as those for enlistment.

(b) **Additional Standards.** In addition to general enlistment standards, presence or history of any of the following will be considered disqualifying for all LCAC duties, unless waived by proper authority (see art. 15-71A(9)).

(1) Ears, Nose, and Throat (ENT)

(a) Seasonal allergic rhinitis requiring medication or allergy immunotherapy for control.

(b) Recurrent attacks of vertigo (no waiver).

(c) Chronic or recurrent otitis externa or media.

(2) **Eyes.** Any ophthalmologic disorder that causes or that may progress to significantly degraded visual acuity.

(3) **Lungs and Chest Wall.** Recurrent spontaneous pneumothorax.

(4) Heart and Vascular

(a) History of cardiac surgery.

(b) Paroxysmal tachycardia or history thereof.

(c) Ventricular tachycardia.

(5) Abdominal Organs and Gastrointestinal (GI) System

(a) Peptic ulcer, gastric ulcer, or history thereof.

(b) Gastrointestinal hemorrhage or history thereof.

(c) Cholelithiasis.

(6) **Endocrine and Metabolic Disorders.** Hypoglycemia or history of any postprandial symptoms resembling those of postprandial syndrome (e.g., postprandial tachycardia, sweating, fatigue, or change in mentation).

(7) **Genitalia and Genitourinary (GU) System.** Recurrent renal calculus or a single episode of renal calculus with demonstrated structural abnormality or metabolic abnormality unresponsive to dietary therapy. A renal stone/metabolic workup must be performed if a history is given of a single prior episode of renal calculus with no other complicating factors.

(8) **Extremities.** Instability or restricted range of motion of the upper or lower extremities that could interfere with normal operation of foot pedals or ability to function in the LCAC environment.

(9) **Spine**

(a) Chronic or disabling back pain or history thereof.

(b) Herniated nucleus pulposus (HNP) or history thereof.

(c) Scoliosis with greater than 30 degrees thoracic or 20 degrees lumbar curvature.

(10) **Neural Disorders**

(a) History of unexplained or recurrent syncope.

(b) History of convulsive seizures of any type (except single simple seizure associated with febrile illness before age 5).

(c) Narcolepsy or history thereof.

(d) Any complicated head injury as outlined in section III of this chapter, including history of posttraumatic unconsciousness of 24 hours or more in duration, posttraumatic amnesia, penetrating head injury, or impaired judgement for 48 or more hours after injury.

(e) Encephalitis occurring 3 years or less prior to examination, meningitis occurring within 1 year of examination, or either disease resulting in neurological sequelae or abnormal neurologic examination.

(f) History of recurrent, incapacitating headache or facial pain or any headache associated with impairment of motor, sensory, visual, or other neurologic function.

(11) **Psychiatric**

(a) Any history of psychosis, eating disorder, or AXIS II disorder of the DSM-III-R must be disqualifying (no waivers).

(b) Other major AXIS I disorders including mood, anxiety, and somatoform disorders must be considered disqualifying but waivable if the individual has been symptom free without treatment for at least 1 year.

(c) Alcohol or drug abuse - disqualifying. Upon satisfactory completion of accepted substance abuse program and total compliance with aftercare program, a waiver may be considered providing 1 year has elapsed post treatment. Continuation of a waiver would be contingent upon continued compliance with aftercare program as well as total abstinence.

(d) Any evidence of anticipated poor adaptability to LCAC duty conditions (claustrophobia, questionable judgement or affect, or poor stress coping skills) is considered disqualifying and requires a psychiatric consultation to consider waiver.

(12) **Systemic Disease and Miscellaneous Conditions.**

(a) Motion sickness, severe or incapacitating, or history thereof.

(b) Recurrent or chronic joint pain or swelling or diagnosed arthritis.

(c) History of heat pyrexia (heat stroke), or documented predisposition to this condition (including disorders of sweat mechanism), or any history of malignant hyperthermia.

(c) **Clarification of Procedures and Standards.**

(1) **General Fitness/Medications.** A notation will be recorded on the SF-88 and SF-93 for individuals receiving medications on a regular basis or within 24 hours of the LCAC examination. In general, individuals requiring medications or whose general fitness might affect their LCAC control proficiency shall not be found qualified for duty aboard the LCAC. Record in box 77 of the individual's SF-88 (e.g., NPQ-LCAC Duty).

(2) **Height and Weight.** All candidates will meet acceptable body fat percentages as per OPNAVINST 6110.1 series. The maximum acceptable body fat percentages for males is 22 percent and for females is 30 percent.

(3) **Cardiovascular System.** History or presence of cardiac arrhythmia, heart murmur, or other evidence of cardiac abnormality is cause for medical referral for clearance for LCAC duty.

(4) **Blood Pressure and Pulse Rate**

(a) **Blood Pressure.** Blood pressure is determined first after the examinee has been supine for at least 5 minutes and second after standing motionless for 3 minutes. A persistent systolic blood pressure of 140 mm or more is disqualifying, and a persistent diastolic blood pressure of 90 mm or more is disqualifying.

(b) **Pulse Rate.** Pulse rate is determined first after the examinee has been recumbent at least 5 minutes and second after standing motionless for 3 minutes (both determinations to coincide with the measurement of blood pressure). An ECG must be obtained in the presence of a relevant history, arrhythmia, or pulse of less than 50 or greater than 110. Resting pulse shall not persistently exceed 100; standing pulse shall not exceed 110.

(5) **Electrocardiogram (ECG).** All candidates must have a 12-lead standard ECG performed at the time of their entrance physical examination. The baseline ECG must be marked *Not To Be Removed From Health Record* and must be retained in the individual's health record until that record is permanently closed. Each baseline ECG, or copy thereof, shall bear adequate identification data including the individual's full name, grade or rate, social security number, and designator.

(6) **Teeth**

(a) Dental Class 1 and Class 2 are considered as qualifying.

(b) If a candidate is dental Class 3 due only to periodontal status not requiring surgery, the candidate will be accepted as qualified after obtaining a dental waiver.

(7) **Articulation.** Candidates must speak clearly and distinctly without accent or impediment of speech that would interfere with radio conversation. Use the Read Aloud Test in art. 15-23 for this determination.

(8) **Mental Health Review.** A mental health review covering the psychiatric items in art. 15-71A(5)(b)(11) and any other pertinent personal history items must be conducted by the medical officer responsible for that candidate's physical examination. A psychiatric referral is not required to obtain this history. This general mental health review will determine the individual's basic stability, motivation, and capacity to maintain acceptable performance under the special stresses encountered during LCAC operation.

(9) **Neurological Examination.** A careful and complete neurological examination must be made. Any neurologic defect which may interfere with LCAC duty requires a neurology consultation.

(10) **Distant Visual Acuity.** For the entrance physical examination, determine visual acuity by using a 20-foot eye lane with standard Goodlite letters. The Armed Forces Vision Tester (AFVT) is an alternate acceptable method. If corrective lenses are necessary for LCAC duty, the LCAC crew personnel must be issued the approved lens-hardened eye glasses for proper interface with operational headgear (i.e., aviation frames). A spare pair of corrective lenses must be carried at all times during operations. For Class I personnel, minimum distant visual acuity must be no less than 20/100 uncorrected each eye and correctable to 20/20 each eye. If correction is necessary for LCAC personnel, corrective lenses must be worn at all times during LCAC operation.

(11) **Near Visual Acuity.** The AFVT or the near vision testing card must be used to test near vision. A minimum near vision acuity of 20/200 in each eye, correctable to 20/20, is acceptable. If correction is necessary, corrective lenses must be worn at all times during LCAC operations.

(12) **Refraction.** Refraction of the eyes must be required on the initial candidate screening examination if the candidate requires corrective lenses to meet the visual acuity standards. For Class I personnel, acceptable limits are $\pm 5.5D$ in any meridian. The difference in the refractive errors in any meridian of the two eyes (anisometropia) may not exceed 3.5D. Cylinder correction may not exceed 3.0D.

(13) **Depth Perception.** This test should be performed using a Verhoeff stereopter. Pass-Fail standards per art. 15-65 (7) must be followed. Normal depth perception is acceptable (aided or unaided). If visual correction is necessary for normal depth perception, corrective lenses must be worn at all times during LCAC operation.

(14) **Oculomotor Balance.** The vertical and lateral phorias may be tested with the phorometer or with the AFVT. Any lateral phoria greater than 10 prism diopters is disqualifying (greater than 6 prism diopters requires an ophthalmologic consultation). Any vertical phoria greater than 1.5 prism

diopters is disqualifying (any vertical phoria greater than 1.0 prism diopters should receive an ophthalmologic consultation).

(15) **Inspection of the Eyes.** Follow art. 15-65(7). The examination must include a fundoscopic examination. Any pathological condition that might become worse or interfere with the proper functioning of the eyes under fatigue or LCAC operating conditions shall disqualify the candidate.

(16) **Color Vision.** Class I crew personnel must pass the Farnsworth Lantern Test.

(17) **Night Vision.** Any indication or history of night blindness disqualifies the candidate due to the importance of night vision to LCAC operations.

(18) **Field of Vision.** Normal fields should be full to confrontation, see art. 15-40. Any visual field defect should receive ophthalmologic referral to rule out underlying pathology.

(19) **Intraocular Tension.** Schiottz, noncontact ("air puff"), or applanation tonometry must be used to measure intraocular tension. Tonometric readings consistently above 20 mm Hg Schiottz in either eye, or a difference of 5 mm Hg Schiottz between the two eyes, should receive an ophthalmologic referral for further evaluation. This condition is disqualifying until ophthalmologic evaluation has been completed. Subsequent medical clearance is based on said ophthalmologic evaluation.

(20) **Ears.** Follow article 15-39(1). General enlistment standards in article 15-39 are accepted as candidate standards, with the exception of audiometric standards. Any disqualifying acute ear disease or disorder by those standards disqualifies the candidate.

(21) **Hearing Tests.** An audiogram is required for all LCAC Class I candidates. An audiogram will also be performed within 90 days of reporting to the assigned assault craft unit, and annually thereafter. Audiometric loss in excess of the following limits for each frequency disqualifies the candidate.

Maximum Hearing Loss (ANSI 1969)

Freq (Hz)	Better Ear (dB)	Worse Ear (dB)
500	35	35
1000	30	50
2000	30	50

(22) **Equilibrium.** Use the self-balancing test (SBT). The examinee stands erect, without shoes, with heels and large toes touching. The examinee then flexes one knee to a right angle, closes the eyes, then attempts to maintain this position for 15 seconds. The results of the test are recorded as "steady," "fairly steady," "unsteady," or "failed." Inability to pass this test for satisfactory equilibrium disqualifies the candidate.

(6) Class IA (Navigator) Candidate Physical Examination and Standards

(a) **General Examination.** Except as modified by this article, the basic physical examination and basic physical standards for acceptance as an LCAC crew candidate are the same as those prescribed for enlistment.

(b) **Additional Standards for Class IA personnel.** The additional physical standards required for Class I personnel are also required for Class IA. The following exceptions apply:

(1) As stated in article 15-71A(4)(b), the entrance physical examinations for Class IA personnel may be performed at any sufficiently equipped and staffed military medical facility, and are not limited to designated LCAC medical examination centers.

(2) Psychomotor testing is not required for Class IA crew candidates.

(3) Distant Visual Acuity: Minimal uncorrected distant visual acuity for Class IA personnel must be no less than 20/200 each eye, correctable to 20/20. If correction is necessary, corrective lenses must be worn at all times during LCAC operations.

(7) **Class II (Loadmaster, Deck Mechanic) Candidate Physical Examination and Standards.** The basic physical examination standards for enlistment are acceptable for Class II LCAC crew candidates. However, each LCAC crew candidate must have a current (within 5 years) physical examination on record and the candidate must meet the physical requirements for general duty. The presence or history of any medical problems will be considered disqualifying for Class II LCAC duties, unless waived by proper authority (see art. 15-71A(9)).

(8) Development of Mandatory Requirements for LCAC Crew Members Who Have Been Medically Suspended From LCAC Duty

(a) There are currently no standards regarding LCAC crew members medically suspended for an extended period from LCAC operations to (1) declare them NPQ from LCAC duty or (2) to make it mandatory for that member to request a medical waiver for the condition causing prior suspension.

(b) Recommend setting 30 days as a time limit for limited or medically restricted duty after which the crew member must be evaluated by a medical officer to determine whether that individual is NPQ for LCAC duty, should be recommended for a medical waiver (see art. 15-71A(9)), or should undergo a medical board.

(9) Medical Waiver Requests

(a) **Class I LCAC Crew Candidates.** Forward medical waiver requests for Class I crew candidates to the Bureau of Naval Personnel (PERS-409C) from the Naval Aerospace Medical Institute (NAMI, Code 26). A copy of all approved waivers must be sent from PERS-409C to NAMI (Code 26) for archival purposes.

(b) **Class IA & II LCAC Crew Candidates.** Forward medical waiver requests for Class IA and Class II crew candidates to PERS-409C via the TYCOM medical officer. A copy of Class IA and Class II approved waivers must be sent from PERS-409C to NAMI (Code 26) for archival purposes.

(c) **Medically-suspended LCAC Crew Personnel.** Forward medical waiver requests for LCAC crew personnel who are medically suspended to the TYCOM medical officer via the chain of command. The TYCOM medical officer must evaluate and approve medical waiver requests for designated LCAC crew personnel (as opposed to LCAC crew candidates). A copy of the TYCOM medical officer's final decision, either an approval or disapproval, concerning the waiver request will be forwarded to NAMI (Code 26) for archival purposes.

(10) Periodic Physical Examinations

(a) All LCAC Class I and Class IA crew personnel will undergo a complete physical examination (using SF 88 and SF 93) within 30 days of the anniversary of their birth at ages 21, 24, 27, 30, 33, 36, and 39 and annually thereafter.

(b) All LCAC Class II personnel will undergo a complete physical examination within 30 days of the anniversary of their birth every 5 years.

(11) **Reporting Attrition of LCAC Crew Personnel.** Critical to the evolution of the LCAC crew evaluation process is the development of accurate personnel data bases, in particular, attrition of LCAC crew personnel. Therefore, all such attritions, medical and nonmedical, are to be reported to NAMI (Code 26) for archival purposes.

15-71B

Explosives Handlers and Explosives Vehicle Operators

(1) **Purpose.** Medical examinations of explosives handlers and explosives vehicle operators are conducted to ensure civilian employees and active duty personnel who operate vehicles or machinery or handle explosives are physically qualified.

(2) Responsibilities

Individuals assigned to duties as operators of vehicles which transport explosives are responsible to report to their supervisor or Medical Department personnel an physical condition which may pose a health or safety hazard to oneself, coworkers, or degrades the safety of the work place.

Supervisors. Personnel assigned as supervisors of explosives handlers and drivers are responsible to direct employ-

APPENDIX 4.
ABILITY CARDS

Category 1

MORE IMPORTANT

The skills and abilities in this category are *exceptionally important* to the successful performance of my job.

Category 2

IMPORTANT

The skills and abilities in this category are *important* to the successful performance of my job.

Category 3

LESS IMPORTANT

The skills and abilities in this category are *less important* to the successful performance of my job.

**LCAC ABILITY SURVEY
COVER CARD**

Name: _____

Crew Position: (Check one, please)

- ☐ Craftmaster
- ☐ Engineer
- ☐ Navigator
- ☐ Loadmaster
- ☐ Deck Mechanic

Experience as LCAC Crew:

____ Years, ____ Months

<p>Spatial Orientation:</p> <p>The ability to maintain orientation with respect to objects, when you or the objects are moving.</p>	<p>Reaction Time:</p> <p>The speed with which a single motor response can be made following the onset of a single stimulus.</p>	<p>Control Precision:</p> <p>The ability to make fine adjustments to a knob or dial.</p>
<p>Arm-Hand Steadiness:</p> <p>The ability to make precise, steady arm-hand positioning movements.</p>	<p>Manual Dexterity:</p> <p>The ability to make skillful, coordinated movements of a hand together with its arm--may involve equipment, but not equipment controls.</p>	<p>Finger Dexterity:</p> <p>The ability to make skillful, coordinated movements of the fingers--may involve equipment, but not equipment controls.</p>
<p>Speed of Limb Movement:</p> <p>The speed with which movements of the arms or legs can be made; the speed with which the movement can be carried out after it has been initiated.</p>	<p>Strength:</p> <p>The amount of muscular force that can be exerted.</p>	<p>Stamina:</p> <p>The ability to maintain physical activity over prolonged periods of time.</p>
<p>Near Vision:</p> <p>The ability to see close environmental surroundings.</p>	<p>Far Vision:</p> <p>The ability to see distant environmental surroundings.</p>	<p>Night Vision:</p> <p>The ability to see under low light conditions.</p>

<p>Color Discrimination:</p> <p>The ability to match or discriminate between colors.</p>	<p>Peripheral Vision:</p> <p>The ability to perceive objects or movement towards the edges of the visual field.</p>	<p>Depth Perception:</p> <p>The ability to distinguish which of several objects is nearer or more distant, or to judge the distance to an object.</p>
<p>Oral Comprehension:</p> <p>The ability to understand spoken English words or sentences.</p>	<p>Written Comprehension:</p> <p>The ability to understand written sentences and paragraphs.</p>	<p>Oral Expression:</p> <p>The ability to speak English words or sentences so others will understand.</p>
<p>Written Expression:</p> <p>The ability to write English words or sentences so others will understand.</p>	<p>Memorization:</p> <p>The ability to remember information, such as words, numbers, pictures, and procedures.</p>	<p>Math Reasoning:</p> <p>The ability to understand and organize a problem and then to select a mathematical method or formula to solve the problem.</p>
<p>Teamwork:</p> <p>The ability to work with others as part of a team, to anticipate what others want or need, and to cooperate.</p>	<p>Assertiveness:</p> <p>The ability to bring a problem or important information to the attention of another crew member in a timely fashion.</p>	<p>Problem Solving:</p> <p>The ability to perceive small details and "size-up" situations quickly and accurately, then respond with an appropriate course of action.</p>

APPENDIX 5.

**LCAC CRAFTMASTER TASKS
RANKED IN DESCENDING ORDER OF**

- 1) OVERALL CRITICALITY**
- 2) DIFFICULTY TO LEARN**
- 3) IMPORTANCE TO MISSION SUCCESS**

CRAFTMASTER TASK LIST 1:
LCAC CRAFTMASTER OPERATIONAL TASKS
IN DESCENDING ORDER OF
OVERALL CRITICALITY

Rank
Order

1. Perform well deck entry with support ship at anchor.
2. Perform well deck entry with support ship underway.
3. Operate craft in high winds over land in daylight.
4. Operate craft in heavy weather, over water, in daylight, in water with sea state of 4 or greater.
5. Traverse slopes (small hills and sand dunes), craft in maneuvering mode.
6. Operate craft at night, using night vision equipment.
7. Transition land-to-water into 4-8 feet of surf.
8. Perform low speed water-to-land transition in smooth water and obstacles on beach.
9. Respond and direct crew response to general craft fire.
10. Tow another craft.
11. Perform water-to-land transition through surf.
12. Operate craft in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
13. Respond and direct crew response to a craft deck cargo fire.
14. Respond to fire in fuel bay.
15. Operate craft while being towed.
16. Make other (i.e., non-navigation) operational decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
17. Perform turn, underway.
18. Respond to loss of main engine.
19. Direct recovery action for audible alarm and fire lights for main engine compartment.
20. Respond to loss of N₂ control.
21. Direct recovery action for loss of N₂ control.
22. Respond and direct crew response to a collision.
23. Make navigation decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.

24. Abandon craft, craft sinking or fire out of control.
25. Perform lateral translation on a slope, craft in maneuvering mode on flat beach.
26. Respond to audible alarm and fire lights for APU compartment.
27. Respond to audible alarm and fire lights for main engine compartment.
28. Back craft down slope, craft in cruise mode, on slope with bow up-slope.
29. Respond to loss of main engine fuel pressure.
30. Position craft for loading/unloading, craft in maneuvering mode.
31. Direct recovery action for loss of a main engine, affected engine secured.
32. Direct recovery action for audible alarm and fire lights for APU compartment.
33. Direct recovery action for loss of main engine fuel pressured.
34. Lift-off and hover over land.
35. Perform high speed water-to-land transition in smooth water and on clear beach.
36. Direct recovery action for loss of lift.
37. Respond to loss of lift.
38. Adjust differential prop pitch, rudders, and bow thrusters to perform a well deck departure.
39. Perform lateral translation in a hover.
40. Transition over hump at critical depth, water depth 8-20 feet.
41. Respond to loss of propeller/propeller control.
42. Make go/no-go decision based on mission plan and other available information.
43. Maintain heading control over hump speed.
44. Direct recovery action for loss of propeller/propeller control.
45. Direct recovery action for post shutdown fire in main engine/APU.
46. Respond and direct crew response to man overboard.
47. Coordinate operational actions with other crew.
48. Respond to open blow-in doors.
49. Coordinate and supervise conduct of preventive maintenance tasks by crew.
50. Respond to transmission high lube oil temperature.
51. Respond to APU high EGT.
52. Direct recovery action for APU high EGT.

53. Execute lateral translation, underway.
54. Coordinate and supervise conduct of preventive maintenance tasks by non-crew personnel.
55. Respond to transmission low lube oil pressure.
56. Respond to APU engine surge/stall.
57. Respond to a post shutdown fire in main engine/APU.
58. Direct recovery action for APU engine surge/stall.
59. Operate craft over ice.
60. Perform ice breaking operations.
61. Transition land-to-water into smooth water, at crest of beach.
62. Respond to main engine low lube oil pressure.
63. Respond to main engine high lube oil temperature.
64. Respond to main engine COMPT OVERTEMP alarm.
65. Direct recovery action for transmission and propeller lube system low oil reservoir.
66. Respond to main engine high EGT
67. Perform an emergency stop, over land.
68. Direct recovery action for main engine low lube oil pressure.
69. Respond to APU high lube oil temperature.
70. Direct recovery action for transmission low lube oil pressure.
71. Direct recovery action for transmission high lube oil temperature.
72. Direct recovery action for APU low lube oil pressure.
73. Respond to main engine COMPT HOT alarm.
74. Respond to APU COMPT HOT alarm.
75. Direct recovery action for main engine high lube oil temperature.
76. Direct recovery action for an open blow-in door.
77. Direct recovery action for loss of bow thruster control.
78. Respond to APU low lube oil pressure.
79. Direct recovery action for main engine COMPT HOT alarm.
80. Direct recovery action for main engine COMPT OVERTEMP alarm.
81. Respond to main engine surge/stall.

82. Direct recovery action for loss of APU.
83. Direct recovery action for APU high lube oil temperature.
84. Adjust differential prop pitch, rudders, and bow thrusters to perform a departure from land.
85. Respond to loss of bow thruster control.
86. Recover from transmission and propeller lube systems low reservoir.
87. Direct recovery action for main engine high EGT.
88. Direct recovery action for stack fire in main engine/APU, stack fire extinguished.
89. Direct jettison of cargo.
90. Direct recovery action for APU COMPT HOT alarm.
91. Direct recovery action for main engine surge/stall.
92. Respond to a chip light indication.
93. Respond to stack fire in main engine/APU.
94. Perform an emergency stop, over water.
95. Direct recovery action for APU fuel pressure.
96. Direct recovery action for APU COMPT OVERTEMP alarm.
97. Maneuver craft to moor to a ship at anchor.
98. Respond to APU COMPT OVERTEMP alarm.
99. Respond to plow-in, craft over hump.
100. Depart ship mooring.
101. Request and receive information from engineer regarding status of engineering systems.
102. Request and receive information from navigator regarding navigation issues.
103. Respond to loss of rudder control.
104. Respond to loss of APU fuel pressure.
105. Direct recovery action for a chip light indication.
106. Establish and maintain electronic communications, using head sets and microphones.
107. Respond to damage to skirt system keel bag.
108. Recover from plow-in.
109. Direct crew personnel, verbally, to conduct specific tasks.
110. Inspect starboard control cabin.

111. Direct recovery action for loss of rudder control.
112. Depart anchorage.
113. Respond to loss of APU.
114. Adjust differential prop pitch, rudders, and bow thrusters to perform a hullborne departure.
115. Inspect fuel bay port aft (2-15-2Q).
116. Inspect fuel bay starboard aft (2-15-1Q).
117. Monitor/assist engineer with main engine start, with craft powered up and APUs on line.
118. Inspect fuel bay port forward (2-4-2Q).
119. Inspect fuel bay starboard forward (2-4-1Q).
120. Maintain heading control under hump speed.
121. Supervise or monitor crew personnel in the performance of their work.
122. Review maintenance documents and logs.
123. Council crew personnel regarding task performance.
124. Direct recovery action for loss of AMS.
125. Perform normal stop over land, craft in maneuvering mode.
126. Respond to loss of generator.
127. Respond/direct recovery from loss of radar.
128. Coordinate crew performance of all checklists.
129. Respond to loss of AMS.
130. Direct recovery action for loss of generator.
131. Inspect fuel equipment compartment starboard.
132. Receive mission plan from navigator and interpret information.
133. Lift-off and hover over water.
134. Request and receive information from engineer or navigator regarding visibility (e.g., other craft, surf, beach, lights, etc.).
135. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
136. Direct recovery action for loss of a transformer/rectifier (T/R).
137. Communicate with personnel aboard other platforms or ashore.
138. Inspect fuel equipment compartment port (2-17-4Q).

139. Respond/direct recovery from loss of DCU.
140. Direct/request non-crew personnel to conduct specific tasks.
141. Respond to loss of transformer/rectifier (T/R).
142. Respond/direct recovery from loss of internal craft communications.
143. Operate craft equipped with cold weather kit.
144. Direct general premission planning process.
145. Request and receive information from loadmaster regarding port-side visibility (e.g., other craft, surf, beach, lights, etc.).
146. Come off cushion (loaded).
147. Monitor/assist engineer with power-up switch initialization.
148. Inspect port side frame 15/fantail.
149. Inspect starboard side frame 15/fantail.
150. Inspect starboard superstructure/01 level.
151. Monitor/assist engineer with main engine shutdown, craft off cushion.
152. Respond/direct recovery from loss of GPS.
153. Transition over hump in shallow water, water depth 1-7 feet.
154. Inspect below deck spaces.
155. Maneuver craft to moor to a pier.
156. Direct refueling of craft.
157. Review written reports and data summaries prepared by crew personnel and others.
158. Prepare written reports, evaluations, and briefings.
159. Report equipment casualties to maintenance control.
160. Maneuver craft to anchor craft
161. Perform walk-around inspection of craft.
162. Perform walk-around inspection of craft.
163. Request and receive information from loadmaster regarding status of cargo, mechanical systems, or deck operations.
164. Transition over hump in deep water, water depth greater than 20 feet.
165. Inspect the starboard superstructure.
166. Inspect the port superstructure.

167. Respond/direct recovery from loss of AHRU.
168. Maneuver craft to moor to a buoy.
169. Respond/direct recovery from loss of AN/VRC-43 transceiver.
170. Respond to loss of communications.
171. Council crew personnel regarding personal issues.
172. Inspect cargo deck.
173. Monitor/assist engineer with APU shutdown with power available.
174. Perform normal stop over water.
175. Respond/direct recovery from loss of HSVL.
176. Inspect port superstructure 01 level.
177. Monitor/assist engineer with APU shutdown with power not available.
178. Respond/direct recovery from loss of AN/VRC-182/182A transceiver.
179. Monitor/assist engineer with APU start with batteries.
180. Respond/direct recovery from loss of AN/VRC-92 transceiver.
181. Monitor/assist engineer with craft power down, with APUs shutdown.
182. Come off cushion (light).
183. Monitor/assist engineer with APU start with power available.
184. Inspect exterior hull.
185. Operate craft in hullborne mode.
186. Monitor/assist engineer with application of external power.
187. Inspect line-handling stations.
188. Come off cushion over water, craft stopped and in hover.
189. Come to low cushion over water, craft stopped and in hover.
190. Inspect port passenger compartment.

CRAFTMASTER TASK LIST 2:

**LCAC CRAFTMASTER OPERATIONAL TASKS
IN DESCENDING ORDER OF**

DIFFICULTY TO LEARN

Rank
Order

1. Operate craft in heavy weather, over water, in daylight, in water with sea state of 4 or greater.
2. Perform well deck entry with support ship at anchor.
3. Operate craft in high winds over land in daylight.
4. Perform well deck entry with support ship underway.
5. Traverse slopes (small hills and sand dunes), craft in maneuvering mode.
6. Tow another craft.
7. Operate craft at night, using night vision equipment.
8. Transition land-to-water into 4-8 feet of surf.
9. Operate craft while being towed.
10. Perform low speed water-to-land transition in smooth water and obstacles on beach.
11. Perform turn, underway.
12. Perform lateral translation on a slope, craft in maneuvering mode on flat beach.
13. Perform water-to-land transition through surf.
14. Perform lateral translation in a hover.
15. Back craft down slope, craft in cruise mode, on slope with bow up-slope.
16. Operate craft in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
17. Respond to loss of N₂ control.
18. Abandon craft, craft sinking or fire out of control.
19. Transition over hump at critical depth, water depth 8-20 feet.
20. Execute lateral translation, underway.
21. Respond to loss of main engine.
22. Direct recovery action for loss of N₂ control.
23. Adjust differential prop pitch, rudders, and bow thrusters to perform a well deck departure.
24. Make go/no-go decision based on mission plan and other available information.

25. Lift-off and hover over land.
26. Respond and direct crew response to general craft fire.
27. Maneuver craft to moor to a ship at anchor.
28. Direct recovery action for loss of main engine fuel pressured.
29. Operate craft over ice.
30. Perform ice breaking operations.
31. Transition land-to-water into smooth water, at crest of beach.
32. Position craft for loading/unloading, craft in maneuvering mode.
33. Make other (i.e., non-navigation) operational decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
34. Respond and direct crew response to a collision.
35. Perform high speed water-to-land transition in smooth water and on clear beach.
36. Respond and direct crew response to a craft deck cargo fire.
37. Respond to fire in fuel bay.
38. Respond to loss of main engine fuel pressure.
39. Depart ship mooring.
40. Maintain heading control under hump speed.
41. Maintain heading control over hump speed.
42. Direct recovery action for loss of a main engine, affected engine secured.
43. Monitor/assist engineer with main engine start, with craft powered up and APUs on line.
44. Adjust differential prop pitch, rudders, and bow thrusters to perform a departure from land.
45. Make navigation decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
46. Direct recovery action for loss of lift.
47. Direct recovery action for audible alarm and fire lights for main engine compartment.
48. Coordinate and supervise conduct of preventive maintenance tasks by non-crew personnel.
49. Direct recovery action for main engine low lube oil pressure.
50. Respond to loss of propeller/propeller control.
51. Maneuver craft to moor to a pier.
52. Direct recovery action for loss of propeller/propeller control.

53. Respond to audible alarm and fire lights for APU compartment.
54. Direct recovery action for post shutdown fire in main engine/APU.
55. Respond and direct crew response to man overboard.
56. Direct recovery action for transmission high lube oil temperature.
57. Direct recovery action for APU high EGT.
58. Direct recovery action for audible alarm and fire lights for APU compartment.
59. Respond to main engine surge/stall.
60. Direct jettison of cargo.
61. Respond to APU high EGT.
62. Depart anchorage.
63. Respond to main engine high lube oil temperature.
64. Direct recovery action for transmission low lube oil pressure.
65. Direct recovery action for APU engine surge/stall.
66. Direct recovery action for main engine high lube oil temperature.
67. Respond to transmission low lube oil pressure.
68. Respond to transmission high lube oil temperature.
69. Direct recovery action for loss of bow thruster control.
70. Respond to loss of lift.
71. Respond to APU engine surge/stall.
72. Direct recovery action for main engine surge/stall.
73. Direct recovery action for main engine high EGT.
74. Respond to main engine low lube oil pressure.
75. Direct recovery action for loss of APU.
76. Respond to audible alarm and fire lights for main engine compartment.
77. Respond to a post shutdown fire in main engine/APU.
78. Adjust differential prop pitch, rudders, and bow thrusters to perform a hullborne departure.
79. Coordinate and supervise conduct of preventive maintenance tasks by crew.
80. Respond to main engine high EGT
81. Direct recovery action for APU low lube oil pressure.

82. Direct recovery action for APU high lube oil temperature.
83. Direct recovery action for an open blow-in door.
84. Direct recovery action for loss of rudder control.
85. Direct recovery action for transmission and propeller lube system low oil reservoir.
86. Respond to APU high lube oil temperature.
87. Respond to open blow-in doors.
88. Respond to main engine COMPT OVERTEMP alarm.
89. Coordinate operational actions with other crew.
90. Monitor/assist engineer with power-up switch initialization.
91. Respond to APU low lube oil pressure.
92. Direct recovery action for main engine COMPT OVERTEMP alarm.
93. Monitor/assist engineer with main engine shutdown, craft off cushion.
94. Respond to loss of bow thruster control.
95. Recover from transmission and propeller lube systems low reservoir.
96. Direct recovery action for APU fuel pressure.
97. Direct recovery action for main engine COMPT HOT alarm.
98. Direct recovery action for APU COMPT HOT alarm.
99. Direct recovery action for APU COMPT OVERTEMP alarm.
100. Maneuver craft to moor to a buoy.
101. Respond to loss of rudder control.
102. Respond to plow-in, craft over hump.
103. Lift-off and hover over water.
104. Prepare written reports, evaluations, and briefings.
105. Direct recovery action for a chip light indication.
106. Direct recovery action for loss of a transformer/rectifier (T/R).
107. Inspect starboard control cabin.
108. Request and receive information from engineer regarding status of engineering systems.
109. Respond to damage to skirt system keel bag.
110. Respond to loss of APU fuel pressure.

111. Respond to APU COMPT HOT alarm.
112. Recover from plow-in.
113. Transition over hump in shallow water, water depth 1-7 feet.
114. Review written reports and data summaries prepared by crew personnel and others.
115. Establish and maintain electronic communications, using head sets and microphones.
116. Respond to a chip light indication.
117. Respond to main engine COMPT HOT alarm.
118. Respond to APU COMPT OVERTEMP alarm.
119. Direct recovery action for stack fire in main engine/APU, stack fire extinguished.
120. Perform normal stop over land, craft in maneuvering mode.
121. Direct general premission planning process.
122. Maneuver craft to anchor craft
123. Respond to loss of APU.
124. Respond to loss of transformer/rectifier (T/R).
125. Respond to stack fire in main engine/APU.
126. Direct/request non-crew personnel to conduct specific tasks.
127. Supervise or monitor crew personnel in the performance of their work.
128. Perform an emergency stop, over land.
129. Monitor/assist engineer with APU shutdown with power available.
130. Monitor/assist engineer with APU shutdown with power not available.
131. Direct recovery action for loss of generator.
132. Direct recovery action for loss of AMS.
133. Respond to loss of generator.
134. Respond/direct recovery from loss of radar.
135. Transition over hump in deep water, water depth greater than 20 feet.
136. Direct crew personnel, verbally, to conduct specific tasks.
137. Review maintenance documents and logs.
138. Come off cushion (loaded).
139. Request and receive information from navigator regarding navigation issues.

- 140. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
- 141. Respond to loss of AMS.
- 142. Respond/direct recovery from loss of GPS.
- 143. Monitor/assist engineer with APU start with batteries.
- 144. Respond/direct recovery from loss of DCU.
- 145. Operate craft equipped with cold weather kit.
- 146. Coordinate crew performance of all checklists.
- 147. Monitor/assist engineer with APU start with power available.
- 148. Inspect fuel bay port aft (2-15-2Q).
- 149. Inspect fuel bay starboard aft (2-15-1Q).
- 150. Inspect below deck spaces.
- 151. Monitor/assist engineer with craft power down, with APUs shutdown.
- 152. Inspect fuel bay port forward (2-4-2Q).
- 153. Inspect fuel bay starboard forward (2-4-1Q).
- 154. Report equipment casualties to maintenance control.
- 155. Perform an emergency stop, over water.
- 156. Receive mission plan from navigator and interpret information.
- 157. Respond/direct recovery from loss of HSVL.
- 158. Respond/direct recovery from loss of AHRU.
- 159. Inspect fuel equipment compartment starboard.
- 160. Inspect fuel equipment compartment port (2-17-4Q).
- 161. Council crew personnel regarding task performance.
- 162. Inspect starboard superstructure/01 level.
- 163. Respond/direct recovery from loss of internal craft communications.
- 164. Perform normal stop over water.
- 165. Operate craft in hullborne mode.
- 166. Council crew personnel regarding personal issues.
- 167. Inspect port side frame 15/antail.

168. Inspect starboard side frame 15/fantail.
169. Communicate with personnel aboard other platforms or ashore.
170. Respond/direct recovery from loss of AN/VRC-92 transceiver.
171. Monitor/assist engineer with application of external power.
172. Inspect the starboard superstructure.
173. Direct refueling of craft.
174. Request and receive information from engineer or navigator regarding visibility (e.g., other craft, surf, beach, lights, etc.).
175. Inspect the port superstructure.
176. Respond/direct recovery from loss of AN/VRC-43 transceiver.
177. Respond to loss of communications.
178. Request and receive information from loadmaster regarding port-side visibility (e.g., other craft, surf, beach, lights, etc.).
179. Come off cushion (light).
180. Request and receive information from loadmaster regarding status of cargo, mechanical systems, or deck operations.
181. Respond/direct recovery from loss of AN/VRC-182/182A transceiver.
182. Inspect port superstructure 01 level.
183. Perform walk-around inspection of craft.
184. Perform walk-around inspection of craft.
185. Inspect exterior hull.
186. Come to low cushion over water, craft stopped and in hover.
187. Inspect cargo deck.
188. Come off cushion over water, craft stopped and in hover.
189. Inspect line-handling stations.
190. Inspect port passenger compartment.

CRAFTMASTER TASK LIST 3:

**LCAC CRAFTMASTER OPERATIONAL TASKS
IN DESCENDING ORDER OF**

IMPORTANCE

Rank
Order

1. Respond to audible alarm and fire lights for main engine compartment.
2. Respond and direct crew response to general craft fire.
3. Respond to fire in fuel bay.
4. Respond and direct crew response to a craft deck cargo fire.
5. Direct recovery action for audible alarm and fire lights for main engine compartment.
6. Perform well deck entry with support ship underway.
7. Respond to audible alarm and fire lights for APU compartment.
8. Perform well deck entry with support ship at anchor.
9. Make other (i.e., non-navigation) operational decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
10. Make navigation decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
11. Operate craft in high winds over land in daylight.
12. Perform an emergency stop, over water.
13. Direct recovery action for audible alarm and fire lights for APU compartment.
14. Perform low speed water-to-land transition in smooth water and obstacles on beach.
15. Respond to loss of lift.
16. Perform an emergency stop, over land.
17. Traverse slopes (small hills and sand dunes), craft in maneuvering mode.
18. Operate craft in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
19. Operate craft in heavy weather, over water, in daylight, in water with sea state of 4 or greater.
20. Perform water-to-land transition through surf.
21. Coordinate operational actions with other crew.
22. Respond to open blow-in doors.
23. Respond to main engine COMPT HOT alarm.

24. Direct recovery action for loss of lift.
25. Respond and direct crew response to a collision.
26. Transition land-to-water into 4-8 feet of surf.
27. Respond to loss of main engine.
28. Direct recovery action for loss of a main engine, affected engine secured.
29. Respond to loss of main engine fuel pressure.
30. Request and receive information from navigator regarding navigation issues.
31. Respond to loss of propeller/propeller control.
32. Respond to APU COMPT HOT alarm.
33. Coordinate and supervise conduct of preventive maintenance tasks by crew.
34. Respond to main engine COMPT OVERTEMP alarm.
35. Respond to stack fire in main engine/APU.
36. Direct recovery action for stack fire in main engine/APU, stack fire extinguished.
37. Respond to a post shutdown fire in main engine/APU.
38. Operate craft at night, using night vision equipment.
39. Direct recovery action for transmission and propeller lube system low oil reservoir.
40. Direct recovery action for main engine COMPT HOT alarm.
41. Respond to a chip light indication.
42. Respond to transmission high lube oil temperature.
43. Direct recovery action for post shutdown fire in main engine/APU.
44. Position craft for loading/unloading, craft in maneuvering mode.
45. Respond to main engine high EGT
46. Respond to main engine low lube oil pressure.
47. Direct recovery action for loss of N₂ control.
48. Direct recovery action for loss of propeller/propeller control.
49. Recover from transmission and propeller lube systems low reservoir.
50. Direct recovery action for main engine COMPT OVERTEMP alarm.
51. Respond and direct crew response to man overboard.
52. Respond to loss of N₂ control.

53. Respond to transmission low lube oil pressure.
54. Respond to loss of bow thruster control.
55. Respond to APU COMPT OVERTEMP alarm.
56. Perform turn, underway.
57. Perform high speed water-to-land transition in smooth water and on clear beach.
58. Council crew personnel regarding task performance.
59. Direct recovery action for an open blow-in door.
60. Direct recovery action for APU COMPT HOT alarm.
61. Respond to main engine high lube oil temperature.
62. Request and receive information from engineer or navigator regarding visibility (e.g., other craft, surf, beach, lights, etc.).
63. Direct crew personnel, verbally, to conduct specific tasks.
64. Direct recovery action for loss of main engine fuel pressured.
65. Direct recovery action for APU fuel pressure.
66. Direct recovery action for APU COMPT OVERTEMP alarm.
67. Request and receive information from engineer regarding status of engineering systems.
68. Respond to loss of APU fuel pressure.
69. Respond to APU low lube oil pressure.
70. Respond to APU high lube oil temperature.
71. Respond to plow-in, craft over hump.
72. Inspect fuel bay port forward (2-4-2Q).
73. Inspect fuel bay starboard forward (2-4-1Q).
74. Inspect fuel bay port aft (2-15-2Q).
75. Inspect fuel bay starboard aft (2-15-1Q).
76. Maintain heading control over hump speed.
77. Direct recovery action for main engine high lube oil temperature.
78. Direct recovery action for transmission low lube oil pressure.
79. Direct recovery action for loss of bow thruster control.
80. Direct recovery action for APU low lube oil pressure.
81. Establish and maintain electronic communications, using head sets and microphones.

82. Respond to loss of rudder control.
83. Respond to APU high EGT.
84. Respond to APU engine surge/stall.
85. Coordinate and supervise conduct of preventive maintenance tasks by non-crew personnel.
86. Lift-off and hover over land.
87. Back craft down slope, craft in cruise mode, on slope with bow up-slope.
88. Direct recovery action for main engine high EGT.
89. Direct recovery action for a chip light indication.
90. Direct recovery action for transmission high lube oil temperature.
91. Direct recovery action for APU high EGT.
92. Direct recovery action for APU engine surge/stall.
93. Direct recovery action for APU high lube oil temperature.
94. Communicate with personnel aboard other platforms or ashore.
95. Respond to damage to skirt system keel bag.
96. Recover from plow-in.
97. Perform lateral translation on a slope, craft in maneuvering mode on flat beach.
98. Request and receive information from loadmaster regarding port-side visibility (e.g., other craft, surf, beach, lights, etc.).
99. Respond to main engine surge/stall.
100. Inspect fuel equipment compartment starboard.
101. Direct recovery action for main engine low lube oil pressure.
102. Adjust differential prop pitch, rudders, and bow thrusters to perform a well deck departure.
103. Direct recovery action for main engine surge/stall.
104. Review maintenance documents and logs.
105. Operate craft while being towed.
106. Tow another craft.
107. Abandon craft, craft sinking or fire out of control.
108. Respond to loss of APU.
109. Receive mission plan from navigator and interpret information.

110. Make go/no-go decision based on mission plan and other available information.
111. Inspect fuel equipment compartment port (2-17-4Q).
112. Perform walk-around inspection of craft.
113. Direct recovery action for loss of APU.
114. Inspect starboard control cabin.
115. Respond/direct recovery from loss of internal craft communications.
116. Transition over hump at critical depth, water depth 8-20 feet.
117. Supervise or monitor crew personnel in the performance of their work.
118. Direct recovery action for loss of rudder control.
119. Inspect port side frame 15/fantail.
120. Inspect starboard side frame 15/fantail.
121. Adjust differential prop pitch, rudders, and bow thrusters to perform a departure from land.
122. Perform walk-around inspection of craft.
123. Respond to loss of generator.
124. Respond/direct recovery from loss of radar.
125. Perform lateral translation in a hover.
126. Coordinate crew performance of all checklists.
127. Inspect starboard superstructure/01 level.
128. Transition land-to-water into smooth water, at crest of beach.
129. Respond to loss of AMS.
130. Inspect cargo deck.
131. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
132. Direct recovery action for loss of AMS.
133. Direct refueling of craft.
134. Perform normal stop over land, craft in maneuvering mode.
135. Request and receive information from loadmaster regarding status of cargo, mechanical systems, or deck operations.
136. Direct recovery action for loss of generator.
137. Execute lateral translation, underway.

- 138. Adjust differential prop pitch, rudders, and bow thrusters to perform a hullborne departure.
- 139. Direct jettison of cargo.
- 140. Come off cushion (loaded).
- 141. Depart anchorage.
- 142. Depart ship mooring.
- 143. Inspect the starboard superstructure.
- 144. Lift-off and hover over water.
- 145. Maneuver craft to moor to a ship at anchor.
- 146. Inspect below deck spaces.
- 147. Report equipment casualties to maintenance control.
- 148. Direct/request non-crew personnel to conduct specific tasks.
- 149. Respond to loss of transformer/rectifier (T/R).
- 150. Inspect the port superstructure.
- 151. Direct general premission planning process.
- 152. Direct recovery action for loss of a transformer/rectifier (T/R).
- 153. Respond/direct recovery from loss of GPS.
- 154. Respond/direct recovery from loss of DCU.
- 155. Inspect port superstructure 01 level.
- 156. Operate craft over ice.
- 157. Respond/direct recovery from loss of AN/VRC-43 transceiver.
- 158. Respond to loss of communications.
- 159. Monitor/assist engineer with main engine start, with craft powered up and APUs on line.
- 160. Respond/direct recovery from loss of AHRU.
- 161. Council crew personnel regarding personal issues.
- 162. Respond/direct recovery from loss of AN/VRC-182/182A transceiver.
- 163. Transition over hump in deep water, water depth greater than 20 feet.
- 164. Maintain heading control under hump speed.
- 165. Perform normal stop over water.
- 166. Monitor/assist engineer with power-up switch initialization.

167. Maneuver craft to anchor craft
168. Transition over hump in shallow water, water depth 1-7 feet.
169. Monitor/assist engineer with main engine shutdown, craft off cushion.
170. Review written reports and data summaries prepared by crew personnel and others.
171. Respond/direct recovery from loss of HSVL.
172. Inspect exterior hull.
173. Prepare written reports, evaluations, and briefings.
174. Inspect line-handling stations.
175. Come off cushion (light).
176. Respond/direct recovery from loss of AN/VRC-92 transceiver.
177. Operate craft equipped with cold weather kit.
178. Monitor/assist engineer with APU shutdown with power available.
179. Monitor/assist engineer with APU start with batteries.
180. Monitor/assist engineer with craft power down, with APUs shutdown.
181. Maneuver craft to moor to a pier.
182. Perform ice breaking operations.
183. Maneuver craft to moor to a buoy.
184. Monitor/assist engineer with APU shutdown with power not available.
185. Monitor/assist engineer with APU start with power available.
185. Come off cushion over water, craft stopped and in hover.
187. Monitor/assist engineer with application of external power.
188. Operate craft in hullborne mode.
189. Come to low cushion over water, craft stopped and in hover.
190. Inspect port passenger compartment.

APPENDIX 6.

**LCAC ENGINEER TASKS
RANKED IN DESCENDING ORDER OF**

- 1) OVERALL CRITICALITY**
- 2) DIFFICULTY TO LEARN**
- 3) IMPORTANCE TO MISSION SUCCESS**

ENGINEER TASK LIST 1:
LCAC ENGINEER OPERATIONAL TASKS
IN DESCENDING ORDER OF
OVERALL CRITICALITY

Rank
Order

1. Respond to general craft fire.
2. Diagnose equipment problems, faults, or casualties.
3. Respond to a craft deck cargo fire.
4. Respond to audible alarm and fire lights for main engine compartment.
5. Respond to fire in fuel bay.
6. Respond to collision.
7. Respond to audible alarm and fire lights for APU compartment.
8. Make engineering decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
9. Abandon craft, craft sinking or fire out of control.
10. Respond to loss of main engine.
11. Acquire and provide information to crew, and make necessary trim and engine speed adjustments, to assist transition over hump at critical depth, water depth 8-20 feet.
12. Respond to main engine surge/stall.
13. Perform engineering duties in heavy weather, over water, in daylight, with sea state of 4 or greater.
14. Respond to loss of main engine fuel pressure.
15. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing well deck entry with support ship underway.
16. Respond to loss of propeller/propeller control.
17. Estimate repair requirements, based on knowledge of crew capabilities and other factors.
18. Respond to transmission low lube oil pressure.
19. Respond to main engine high EGT
20. Direct crew personnel, verbally, to conduct specific tasks.
21. Respond to main engine high lube oil temperature.
22. Respond to main engine low lube oil pressure.

23. Respond to main engine COMPT OVERTEMP alarm.
24. Respond to APU COMPT OVERTEMP alarm.
25. Perform engineering duties at night, using night vision equipment.
26. Respond to man overboard.
27. Supervise personnel in the performance of engineering tasks or other work.
28. Respond to loss of N₂ control.
29. Respond to transmission high lube oil temperature.
30. Recover from audible alarm and fire lights for main engine compartment.
31. Respond to open blow-in doors.
32. Respond to a post shutdown fire in main engine/APU.
33. Jettison cargo.
34. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing well deck entry with support ship at anchor.
35. Respond to loss of AMS.
36. Respond to loss of lift.
37. Perform an emergency stop, over water.
38. Transfer fuel to maintain optimum trim, craft underway.
39. Respond to loss of bow thruster control.
40. Respond to stack fire in main engine/APU.
41. Recover from audible alarm and fire lights for APU compartment.
42. Perform engineering duties in high winds over land in daylight.
43. Maintain log of custody of equipment and logs.
44. Respond to loss of APU.
45. Coordinate operational actions with other crew.
46. Perform an emergency stop, over land.
47. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist transition land-to-water into 4-8 feet of surf.
48. Perform recovery action for loss of a main engine, affected engine secured
49. Respond to transmission and propeller lube system low oil reservoir.
50. Respond to APU COMPT HOT alarm.

51. Respond to damage to skirt system keel bag.
52. Respond to loss of rudder control.
53. Respond to main engine COMPT HOT alarm.
54. Perform engineering duties in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
55. Respond to a chip light indication.
56. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing lateral translation on a slope.
57. Coordinate performance of all checklists.
58. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in traversing slopes (small hills and sand dunes), craft in maneuvering mode.
59. Maintain component record cards.
60. Enter data to generate a job sequence number (JSN) to initiate a repair.
61. Recover from post shutdown fire in main engine/APU.
62. Adjust cushion vanes and engine speed, and provide information to crew to come off cushion (loaded).
63. Direct/supervise installation of cold weather kit.
64. Adjust cushion vanes and engine speed to perform a well deck departure.
65. Recover from main engine surge/stall.
66. Recover from loss of main engine fuel pressured.
67. Respond to APU high EGT.
68. Respond to loss of APU fuel pressure.
69. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist mooring to a ship at anchor.
70. Respond to APU high lube oil temperature.
71. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in backing craft down slope, craft in cruise mode, on slope with bow up-slope.
72. Recover from transmission low lube oil pressure.
73. Respond to APU low lube oil pressure.
74. Calculate fuel requirements based on cargo weight and other conditions.
75. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist in performing low speed water-to-land transition, craft in maneuver mode in smooth water and obstacles on beach.

76. Recover from main engine high EGT.
77. Recover from main engine high lube oil temperature.
78. Perform engineering duties over ice.
79. Perform engineering duties during ice breaking operations.
80. Perform main engine start, with craft powered up and APUs on line.
81. Respond to loss of generator.
82. Adjust cushion vanes and engine speed, and provide information to crew to perform a hullborne departure.
83. Recover from loss of AMS.
84. Recover from main engine COMPT OVERTEMP alarm.
85. Respond to plow-in, craft over hump.
86. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist mooring to a pier.
87. Maintain hazardous materials inventory.
88. Acquire and provide information to crew, and make necessary trim and engine speed adjustments, to assist transition over hump in shallow water, water depth 1-7 feet.
89. Recover from loss of N₂ control.
90. Recover from main engine low lube oil pressure.
91. Monitor cold weather systems and make necessary adjustments to operate craft in cold weather.
92. Respond to APU engine surge/stall.
93. Adjust cushion vanes and engine speed to perform a departure from land.
94. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist with lift-off and hover over land.
95. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist with lift-off and hover over water.
96. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist with transition land-to-water into smooth water, at crest of beach.
97. Perform engine water wash with deck mechanic or other crew member.
98. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist departure from ship mooring.
99. Recover from transmission high lube oil temperature.
100. Recover from loss of propeller/propeller control.

101. Recover from loss of bow thruster control.
102. Recover from loss of APU.
103. Direct/request non-crew personnel to conduct specific tasks.
104. Recover from APU COMPT OVERTEMP alarm.
105. Inspect circuit breakers, halon switches, fuel pre-heat panels, engine start/stop panel, etc., in preparation for power-up.
106. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist in performing high speed water-to-land transition, craft in cruise mode in smooth water and on clear beach.
107. Recover from loss of lift.
108. Assist in cold weather start operation.
109. Assist in cold weather shutdown procedures.
110. Verify cold weather systems operation.
111. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist in performing water-to-land transition through surf, craft in cruise mode.
112. Recover from APU COMPT HOT alarm.
113. Maintain engine hour log.
114. Recover from main engine COMPT HOT alarm.
115. Acquire and provide information to crew, and make necessary trim and engine speed adjustments, to assist transition over hump in deep water, water depth greater than 20 feet.
116. Review, evaluate, and file craft advisories.
117. Recover from transmission and propeller lube systems low reservoir.
118. Adjust cushion vanes and engine speed, and provide information to crew to come off cushion (light).
119. Maintain crew safety training records and materials.
120. Maintain ACV flight log.
121. Recover from an open blow-in door.
122. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist mooring to a buoy.
123. Recover from APU high EGT.
124. Recover from stack fire in main engine/APU, stack fire extinguished.

125. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in positioning craft for loading/unloading, craft in maneuvering mode.
126. Communicate with personnel aboard other platforms or ashore.
127. Recover from loss of rudder control.
128. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
129. Recover from loss of APU fuel pressure.
130. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist anchoring craft.
131. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing normal stop over land, craft in maneuvering mode.
132. Recover from plow-in.
133. Recover from a chip light indication.
134. Recover from APU engine surge/stall.
135. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist departure from anchorage.
136. Receive, enter, and file oil analysis results.
137. Request and receive information from loadmaster regarding status of cargo, mechanical systems, or deck operations.
138. Recover from APU low lube oil pressure.
139. Recover from APU high lube oil temperature.
140. Report equipment casualties to control point.
141. Prepare oil analysis request and send/deliver oil to lab.
142. Recover from loss of generator.
143. Request and receive information from loadmaster regarding port-side visibility (e.g., other craft, surf, beach, lights, etc.)
144. Perform craft power down, with APUs shutdown.
145. Respond to loss of transformer/rectifier (T/R).
146. Perform gravity refueling.
147. Perform APU start with batteries.
148. Perform main engine shutdown, craft off cushion.
149. Request and receive information from craftmaster regarding operational issues.
150. Create monthly engine hour reports.

151. Perform pressure refueling.
152. Request and receive information from craftmaster or navigator regarding visibility (e.g., other craft, surf, beach, lights, etc.).
153. Perform APU shutdown with power not available.
154. Establish and maintain electronic communications, using head sets and microphones.
155. Respond to loss of communications.
156. Perform power-up switch initialization.
157. Perform APU shutdown with power available.
158. Acquire and provide information to crew, and make necessary engine speed adjustments, to assist in maintaining heading control under hump speed.
159. Acquire and provide information to crew, and make necessary engine speed adjustments, to assist in maintaining heading control over hump speed.
160. Calculate N₂ settings for load, using appropriate table.
161. Perform APU start with power available.
162. Inspect fuel bay port aft (2-15-2Q).
163. Perform pressure defueling.
164. Request and receive information from navigator regarding navigation issues.
165. Perform walk-around inspection of craft.
166. Inspect below deck spaces.
167. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in operating craft in hullborne mode.
168. Inspect fuel bay port forward (2-4-2Q).
169. Inspect fuel bay starboard forward (2-4-1Q).
170. Inspect fuel bay starboard aft (2-15-1Q).
171. Inspect starboard side frame 15/fantail.
172. Inspect port side frame 15/fantail.
173. Recover from loss of a transformer/rectifier (T/R).
174. Inspect starboard control cabin.
175. Inspect exterior hull.
176. Participate in general premission planning process.

- 177. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing lateral translation in a hover.
- 178. Inspect fuel equipment compartment starboard.
- 179. Inspect fuel equipment compartment port (2-17-4Q).
- 180. Acquire and provide information to crew, and make necessary engine speed adjustments, to assist in coming to low cushion over water, craft stopped and in hover.
- 181. Inspect starboard superstructure.
- 182. Inspect port superstructure.
- 183. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing normal stop over water.
- 184. Maintain fuel log.
- 185. Receive cargo weight and number of passengers from loadmaster.
- 186. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in executing lateral translation, underway.
- 187. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in coming off cushion over water, craft stopped and in hover.
- 188. Apply external power.
- 189. Create daily status report.
- 190. Perform walk-around inspection of craft.
- 191. Create weekly engine hour reports.
- 192. Inspect starboard superstructure/01 level.
- 193. Inspect port superstructure 01 level.
- 194. Inspect cargo deck.
- 195. Inspect port passenger compartment.

ENGINEER TASK LIST 2:
LCAC ENGINEER OPERATIONAL TASKS
IN DESCENDING ORDER OF
DIFFICULTY TO LEARN

Rank
Order

1. Diagnose equipment problems, faults, or casualties.
2. Respond to general craft fire.
3. Respond to a craft deck cargo fire.
4. Make engineering decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
5. Respond to audible alarm and fire lights for main engine compartment.
6. Perform engineering duties over ice.
7. Estimate repair requirements, based on knowledge of crew capabilities and other factors.
8. Respond to collision.
9. Respond to fire in fuel bay.
10. Respond to audible alarm and fire lights for APU compartment.
11. Abandon craft, craft sinking or fire out of control.
12. Perform engineering duties in heavy weather, over water, in daylight, with sea state of 4 or greater.
13. Acquire and provide information to crew, and make necessary trim and engine speed adjustments, to assist transition over hump at critical depth, water depth 8-20 feet.
14. Respond to loss of main engine.
15. Respond to main engine surge/stall.
16. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing well deck entry with support ship underway.
17. Perform engineering duties at night, using night vision equipment.
18. Jettison cargo.
19. Respond to loss of main engine fuel pressure.
20. Perform engineering duties during ice breaking operations.
21. Respond to damage to skirt system keel bag.

22. Respond to transmission low lube oil pressure.
23. Direct/supervise installation of cold weather kit.
24. Respond to main engine high EGT
25. Respond to loss of propeller/propeller control.
26. Perform engineering duties in high winds over land in daylight.
27. Respond to main engine high lube oil temperature.
28. Respond to loss of lift.
29. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing well deck entry with support ship at anchor.
30. Direct crew personnel, verbally, to conduct specific tasks.
31. Maintain log of custody of equipment and logs.
32. Respond to loss of AMS.
33. Respond to stack fire in main engine/APU.
34. Respond to man overboard.
35. Respond to APU COMPT OVERTEMP alarm.
36. Supervise personnel in the performance of engineering tasks or other work.
37. Respond to main engine COMPT OVERTEMP alarm.
38. Respond to main engine low lube oil pressure.
39. Respond to loss of bow thruster control.
40. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist mooring to a pier.
41. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing lateral translation on a slope.
42. Maintain ACV flight log.
43. Recover from audible alarm and fire lights for main engine compartment.
44. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in traversing slopes (small hills and sand dunes), craft in maneuvering mode.
45. Respond to open blow-in doors.
46. Respond to transmission high lube oil temperature.
47. Respond to transmission and propeller lube system low oil reservoir.
48. Respond to loss of APU.

49. Respond to a post shutdown fire in main engine/APU.
50. Respond to loss of N₂ control.
51. Respond to APU COMPT HOT alarm.
52. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist departure from ship mooring.
53. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist mooring to a ship at anchor.
54. Coordinate operational actions with other crew.
55. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist transition land-to-water into 4-8 feet of surf.
56. Transfer fuel to maintain optimum trim, craft underway.
57. Respond to main engine COMPT HOT alarm.
58. Maintain hazardous materials inventory.
59. Calculate fuel requirements based on cargo weight and other conditions.
60. Adjust cushion vanes and engine speed to perform a well deck departure.
61. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in backing craft down slope, craft in cruise mode, on slope with bow up-slope.
62. Maintain component record cards.
63. Enter data to generate a job sequence number (JSN) to initiate a repair.
64. Respond to loss of rudder control.
65. Respond to APU low lube oil pressure.
66. Adjust cushion vanes and engine speed, and provide information to crew to perform a hullborne departure.
67. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist mooring to a buoy.
68. Review, evaluate, and file craft advisories.
69. Respond to APU high EGT.
70. Respond to loss of APU fuel pressure.
71. Recover from audible alarm and fire lights for APU compartment.
72. Perform engineering duties in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
73. Perform recovery action for loss of a main engine, affected engine secured.

74. Respond to APU engine surge/stall.
75. Respond to APU high lube oil temperature.
76. Respond to loss of generator.
77. Adjust cushion vanes and engine speed, and provide information to crew to come off cushion (loaded).
78. Perform an emergency stop, over land.
79. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist in performing low speed water-to-land transition, craft in maneuver mode in smooth water and obstacles on beach.
80. Respond to plow-in, craft over hump.
81. Perform an emergency stop, over water.
82. Direct/request non-crew personnel to conduct specific tasks.
83. Acquire and provide information to crew, and make necessary trim and engine speed adjustments, to assist transition over hump in shallow water, water depth 1-7 feet.
84. Recover from main engine surge/stall.
85. Coordinate performance of all checklists.
86. Adjust cushion vanes and engine speed to perform a departure from land.
87. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist with lift-off and hover over water.
88. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist with transition land-to-water into smooth water, at crest of beach.
89. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist in performing high speed water-to-land transition, craft in cruise mode in smooth water and on clear beach.
90. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist in performing water-to-land transition through surf, craft in cruise mode.
91. Perform main engine start, with craft powered up and APUs on line.
92. Acquire and provide information to crew, and make necessary trim and engine speed adjustments, to assist transition over hump in deep water, water depth greater than 20 feet.
93. Recover from loss of main engine fuel pressured.
94. Recover from main engine high lube oil temperature.
95. Respond to a chip light indication.
96. Recover from transmission low lube oil pressure.

97. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist anchoring craft.
98. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in positioning craft for loading/unloading, craft in maneuvering mode.
99. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist departure from anchorage.
100. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist with lift-off and hover over land.
101. Recover from loss of AMS.
102. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing normal stop over land, craft in maneuvering mode.
103. Communicate with personnel aboard other platforms or ashore.
104. Recover from post shutdown fire in main engine/APU.
105. Recover from main engine low lube oil pressure.
106. Perform engine water wash with deck mechanic or other crew member.
107. Adjust cushion vanes and engine speed, and provide information to crew to come off cushion (light).
108. Recover from main engine high EGT.
109. Recover from loss of lift.
110. Recover from main engine COMPT OVERTEMP alarm.
111. Receive, enter, and file oil analysis results.
112. Recover from transmission high lube oil temperature.
113. Recover from loss of bow thruster control.
114. Recover from transmission and propeller lube systems low reservoir.
115. Recover from loss of APU.
116. Recover from APU COMPT HOT alarm.
117. Maintain crew safety training records and materials.
118. Report equipment casualties to control point.
119. Recover from loss of N₂ control.
120. Recover from APU high EGT.
121. Recover from main engine COMPT HOT alarm.
122. Recover from APU COMPT OVERTEMP alarm.

- 123. Recover from plow-in.
- 124. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing lateral translation in a hover.
- 125. Acquire and provide information to crew, and make necessary engine speed
- 126. Acquire and provide information to crew, and make necessary engine speed adjustments, to assist in maintaining heading control over hump speed.
- 127. Maintain engine hour log.
- 128. Prepare oil analysis request and send/deliver oil to lab.
- 129. Recover from loss of propeller/propeller control.
- 130. Respond to loss of transformer/rectifier (T/R).
- 131. Perform gravity refueling.
- 132. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in executing lateral translation, underway.
- 133. Recover from an open blow-in door.
- 134. Recover from APU engine surge/stall.
- 135. Recover from loss of APU fuel pressure.**
- 136. Recover from stack fire in main engine/APU, stack fire extinguished.
- 137. Respond to loss of communications.
- 138. Inspect circuit breakers, halon switches, fuel pre-heat panels, engine start/stop panel, etc., in preparation for power-up.
- 139. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in operating craft in hullborne mode.
- 140. Recover from loss of rudder control.
- 141. Recover from APU low lube oil pressure.
- 142. Recover from APU high lube oil temperature.
- 143. Assist in cold weather start operation.
- 144. Assist in cold weather shutdown procedures.
- 145. Verify cold weather systems operation.
- 146. Monitor cold weather systems and make necessary adjustments to operate craft in cold weather.
- 147. Acquire and provide information to crew, and make necessary engine speed adjustments, to assist in coming to low cushion over water, craft stopped and in hover.
- 148. Recover from loss of generator.

149. Participate in general premission planning process.
150. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing normal stop over water.
151. Establish and maintain electronic communications, using head sets and microphones.
152. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
153. Create monthly engine hour reports.
154. Perform main engine shutdown, craft off cushion.
155. Perform craft power down, with APUs shutdown.
156. Recover from a chip light indication.
157. Inspect starboard control cabin.
158. Perform APU shutdown with power available.
159. Perform APU shutdown with power not available.
160. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in coming off cushion over water, craft stopped and in hover.
161. Request and receive information from navigator regarding navigation issues.
162. Request and receive information from loadmaster regarding status of cargo, mechanical systems, or deck operations.
163. Create weekly engine hour reports.
164. Perform power-up switch initialization.
165. Perform APU start with power available.
166. Perform APU start with batteries.
167. Maintain fuel log.
168. Recover from loss of a transformer/rectifier (T/R).
169. Create daily status report.
170. Request and receive information from loadmaster regarding port-side visibility (e.g., other craft, surf, beach, lights, etc.).
171. Request and receive information from craftmaster or navigator regarding visibility (e.g., other craft, surf, beach, lights, etc.).
172. Perform pressure refueling.
173. Perform pressure defueling.
174. Request and receive information from craftmaster regarding operational issues.

- 175. Perform walk-around inspection of craft.
- 176. Inspect port side frame 15/fantail.
- 177. Inspect starboard side frame 15/fantail.
- 178. Inspect fuel bay port aft (2-15-2Q).
- 179. Inspect fuel bay starboard aft (2-15-1Q).
- 180. Calculate N₂ settings for load, using appropriate table.
- 181. Receive cargo weight and number of passengers from loadmaster.
- 182. Apply external power.
- 183. Inspect fuel bay port forward (2-4-2Q).
- 184. Inspect fuel bay starboard forward (2-4-1Q).
- 185. Inspect fuel equipment compartment starboard.
- 186. Inspect fuel equipment compartment port (2-17-4Q).
- 187. Inspect starboard superstructure.
- 188. Inspect port superstructure.
- 189. Inspect below deck spaces.
- 190. Inspect exterior hull.
- 191. Inspect starboard superstructure/01 level.
- 192. Inspect port superstructure 01 level.
- 193. Perform walk-around inspection of craft.
- 194. Inspect port passenger compartment.
- 195. Inspect cargo deck.

ENGINEER TASK LIST 3:
LCAC ENGINEER OPERATIONAL TASKS
IN DESCENDING ORDER OF
IMPORTANCE

Rank
Order

1. Respond to general craft fire.
2. Respond to a craft deck cargo fire.
3. Respond to audible alarm and fire lights for main engine compartment.
4. Respond to audible alarm and fire lights for APU compartment.
5. Respond to fire in fuel bay.
6. Diagnose equipment problems, faults, or casualties.
7. Respond to collision.
8. Respond to loss of main engine.
9. Abandon craft, craft sinking or fire out of control.
10. Perform an emergency stop, over water.
11. Respond to loss of propeller/propeller control.
12. Respond to loss of main engine fuel pressure.
13. Respond to main engine surge/stall.
14. Respond to loss of N₂ control.
15. Make engineering decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
16. Direct crew personnel, verbally, to conduct specific tasks.
17. Respond to main engine high EGT
18. Respond to main engine low lube oil pressure.
19. Respond to transmission low lube oil pressure.
20. Respond to transmission high lube oil temperature.
21. Acquire and provide information to crew, and make necessary trim and engine speed adjustments, to assist transition over hump at critical depth, water depth 8-20 feet.
22. Respond to main engine COMPT OVERTEMP alarm.

23. Respond to main engine high lube oil temperature.
24. Respond to open blow-in doors.
25. Respond to APU COMPT OVERTEMP alarm.
26. Recover from audible alarm and fire lights for APU compartment.
27. Respond to man overboard.
28. Recover from audible alarm and fire lights for main engine compartment.
29. Perform an emergency stop, over land.
30. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing well deck entry with support ship underway.
31. Transfer fuel to maintain optimum trim, craft underway.
32. Supervise personnel in the performance of engineering tasks or other work.
33. Respond to a chip light indication.
34. Respond to a post shutdown fire in main engine/APU.
35. Perform recovery action for loss of a main engine, affected engine secured.
36. Perform engineering duties in heavy weather, over water, in daylight, with sea state of 4 or greater.
37. Coordinate operational actions with other crew.
38. Coordinate performance of all checklists.
39. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing well deck entry with support ship at anchor.
40. Respond to loss of bow thruster control.
41. Respond to loss of AMS.
42. Respond to loss of lift.
43. Recover from post shutdown fire in main engine/APU.
44. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist transition land-to-water into 4-8 feet of surf.
45. Recover from main engine high EGT.
46. Respond to loss of rudder control.
47. Respond to loss of APU.
48. Perform engineering duties in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
49. Inspect circuit breakers, halon switches, fuel pre-heat panels, engine start/stop panel, etc., in preparation for power-up.

50. Recover from loss of main engine fuel pressured.
51. Recover from loss of N₂ control.
52. Respond to main engine COMPT HOT alarm.
53. Respond to APU COMPT HOT alarm.
54. Recover from main engine COMPT OVERTEMP alarm.
55. Recover from transmission low lube oil pressure.
56. Recover from loss of propeller/propeller control.
57. Respond to transmission and propeller lube system low oil reservoir.
58. Respond to stack fire in main engine/APU.
59. Perform engineering duties at night, using night vision equipment.
60. Maintain component record cards.
61. Maintain log of custody of equipment and logs.
62. Enter data to generate a job sequence number (JSN) to initiate a repair.
63. Recover from main engine surge/stall.
64. Recover from main engine high lube oil temperature.
65. Recover from APU COMPT OVERTEMP alarm
66. Perform main engine start, with craft powered up and APUs on line.
67. Estimate repair requirements, based on knowledge of crew capabilities and other factors.
68. Recover from main engine low lube oil pressure.
69. Recover from loss of AMS.
70. Jettison cargo.
71. Perform engineering duties in high winds over land in daylight.
72. Maintain engine hour log.
73. Recover from transmission high lube oil temperature.
74. Recover from loss of bow thruster control.
75. Recover from loss of APU.
76. Perform engine water wash with deck mechanic or other crew member.
77. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist in performing low speed water-to-land transition, craft in maneuver mode in smooth water and obstacles on beach.

78. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing lateral translation on a slope.
79. Respond to APU high lube oil temperature.
80. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in traversing slopes (small hills and sand dunes), craft in maneuvering mode.
81. Respond to APU high EGT.
82. Respond to loss of APU fuel pressure.
83. Recover from loss of lift.
84. Adjust cushion vanes and engine speed to perform a well deck departure.
85. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist with lift-off and hover over land.
86. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
87. Recover from an open blow-in door.
88. Recover from main engine COMPT HOT alarm.
89. Recover from APU COMPT HOT alarm.
90. Adjust cushion vanes and engine speed, and provide information to crew to come off cushion (loaded).
91. Acquire and provide information to crew, and make necessary trim and engine speed adjustments, to assist transition over hump in shallow water, water depth 1-7 feet.
92. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in backing craft down slope, craft in cruise mode, on slope with bow up-slope.
93. Recover from a chip light indication.
94. Respond to damage to skirt system keel bag.
95. Respond to APU low lube oil pressure.
96. Respond to loss of generator.
97. Respond to plow-in, craft over hump.
98. Calculate fuel requirements based on cargo weight and other conditions.
99. Adjust cushion vanes and engine speed to perform a departure from land.
100. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist with lift-off and hover over water.
101. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist with transition land-to-water into smooth water, at crest of beach.

102. Request and receive information from loadmaster regarding status of cargo, mechanical systems, or deck operations.
103. Recover from loss of rudder control.
104. Recover from transmission and propeller lube systems low reservoir.
105. Recover from stack fire in main engine/APU, stack fire extinguished.
106. Request and receive information from loadmaster regarding port-side visibility (e.g., other craft, surf, beach, lights, etc.).
107. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist mooring to a ship at anchor.
108. Adjust cushion vanes and engine speed, and provide information to crew to come off cushion (light).
109. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist in performing high speed water-to-land transition, craft in cruise mode in smooth water and on clear beach.
110. Request and receive information from craftmaster regarding operational issues.
111. Recover from APU high EGT.
112. Respond to APU engine surge/stall.
113. Recover from loss of APU fuel pressure.
114. Calculate N₂ settings for load, using appropriate table.
115. Inspect fuel bay port aft (2-15-2Q).
116. Acquire and provide information to crew, and make necessary cushion vane, trim, and engine speed adjustments, to assist in performing water-to-land transition through surf, craft in cruise mode.
117. Inspect below deck spaces.
118. Adjust cushion vanes and engine speed, and provide information to crew to perform a hullborne departure.
119. Request and receive information from craftmaster or navigator regarding visibility (e.g., other craft, surf, beach, lights, etc.).
120. Maintain crew safety training records and materials.
121. Acquire and provide information to crew, and make necessary trim and engine speed adjustments, to assist transition over hump in deep water, water depth greater than 20 feet.
122. Perform pressure refueling.
123. Maintain hazardous materials inventory.
124. Perform APU start with batteries.

125. Perform craft power down, with APUs shutdown.
126. Recover from APU engine surge/stall.
127. Recover from APU low lube oil pressure.
128. Recover from loss of generator.
129. Inspect fuel bay port forward (2-4-2Q).
130. Inspect fuel bay starboard forward (2-4-1Q).
131. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist mooring to a pier.
132. Recover from APU high lube oil temperature.
133. Inspect fuel bay starboard aft (2-15-1Q).
134. Recover from plow-in.
135. Communicate with personnel aboard other platforms or ashore.
136. Perform main engine shutdown, craft off cushion.
137. Perform APU shutdown with power not available.
138. Inspect starboard side frame 15/fantail.
139. Direct/request non-crew personnel to conduct specific tasks.
140. Perform walk-around inspection of craft.
141. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in positioning craft for loading/unloading, craft in maneuvering mode.
142. Inspect exterior hull.
143. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist departure from ship mooring.
144. Perform power-up switch initialization.
145. Create monthly engine hour reports.
146. Inspect port side frame 15/fantail.
147. Perform pressure defueling.
148. Perform APU shutdown with power available.
149. Establish and maintain electronic communications, using head sets and microphones.
150. Review, evaluate, and file craft advisories.
151. Prepare oil analysis request and send/deliver oil to lab.
152. Perform APU start with power available.

153. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing normal stop over land, craft in maneuvering mode.
154. Report equipment casualties to control point.
155. Respond to loss of communications.
156. Inspect fuel equipment compartment starboard.
157. Inspect fuel equipment compartment port (2-17-4Q).
158. Monitor cold weather systems and make necessary adjustments to operate craft in cold weather.
159. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist anchoring craft.
160. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist mooring to a buoy.
161. Request and receive information from navigator regarding navigation issues
162. Respond to loss of transformer/rectifier (T/R).
163. Perform walk-around inspection of craft.
164. Receive, enter, and file oil analysis results.
165. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist departure from anchorage.
166. Assist in cold weather start operation.
167. Verify cold weather systems operation.
168. Inspect port superstructure.
169. Recover from loss of a transformer/rectifier (T/R).
170. Inspect starboard superstructure.
171. Acquire and provide information to crew, and make necessary engine speed adjustments, to assist in maintaining heading control under hump speed.
172. Acquire and provide information to crew, and make necessary engine speed adjustments, to assist in maintaining heading control over hump speed.
173. Assist in cold weather shutdown procedures.
174. Receive cargo weight and number of passengers from loadmaster.
175. Inspect starboard control cabin.
176. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in operating craft in hullborne mode.
177. Maintain ACV flight log.

178. Perform gravity refueling.
179. Inspect starboard superstructure/01 level.
180. Apply external power.
181. Direct/supervise installation of cold weather kit.
182. Participate in general premission planning process.
183. Inspect port superstructure 01 level.
184. Maintain fuel log.
185. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing normal stop over water.
186. Acquire and provide information to crew, and make necessary engine speed adjustments, to assist in coming to low cushion over water, craft stopped and in hover.
187. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in coming off cushion over water, craft stopped and in hover.
188. Create daily status report.
189. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in performing lateral translation in a hover.
190. Acquire and provide information to crew, and make necessary cushion vane and engine speed adjustments, to assist in executing lateral translation, underway.
191. Inspect cargo deck.
192. Create weekly engine hour reports.
193. Perform engineering duties over ice.
194. Inspect port passenger compartment.
195. Perform engineering duties during ice breaking operations.

APPENDIX 7.

LCAC NAVIGATOR TASKS RANKED IN DESCENDING ORDER OF

- 1) OVERALL CRITICALITY**
- 2) DIFFICULTY TO LEARN**
- 3) IMPORTANCE TO MISSION SUCCESS**

NAVIGATOR TASK LIST 1:
LCAC NAVIGATOR OPERATIONAL TASKS
IN DESCENDING ORDER OF
OVERALL CRITICALITY

Rank
Order

1. Perform navigator duties in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
2. Activate the global positioning system (GPS).
3. Perform navigator duties at night, using night vision equipment.
4. Make navigation decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
5. Serve as safety officer on deck to assist anchoring craft.
6. Serve as safety officer on deck to assist mooring to a ship at anchor.
7. Respond to collision.
8. Serve as safety officer on deck to assist mooring to a pier.
9. Develop mission plan, using appropriate formulas and collected information, and present plan to craftmaster for review.
10. Serve as safety officer on deck to assist departure from ship mooring.
11. Respond to man overboard.
12. Respond to a craft deck cargo fire.
13. Serve as safety officer on deck to assist departure from anchorage.
14. Respond to general craft fire.
15. Abandon craft, craft sinking or fire out of control.
16. Plot a track with dead reckoning navigation.
17. Perform navigator duties in heavy weather over water, in daylight, with sea state of 4 or greater.
18. Serve as safety officer on deck to assist mooring to a buoy.
19. Prepare a navigation run.
20. Operate/monitor the GPS and provide navigation information to crew.
21. Perform navigator duties over ice.
22. Perform navigator duties during ice breaking operations.

23. Perform navigator duties during cold weather operations.
24. Read, interpret, and update nautical charts.
25. Order materials and replacement parts through MRMS.
26. Jettison cargo.
27. Inspect fuel bay starboard aft (2-15-1Q).
28. Coordinate operational actions with other crew.
29. Respond/recover from loss of radar.
30. Operate the AN/ARC-182/AN/ARC-182A transceiver and applicable secure voice equipment.
31. Operate/monitor the radar and provide navigation information to crew.
32. Acquire and provide information to crew to assist in performing turn, underway.
33. Activate radar and HSVL, and acquire and provide information to crew to assist transition land-to-water into 4-8 feet of surf.
34. Establish and maintain electronic communications, using head sets and microphones.
35. Perform navigator duties in high winds over land in daylight.
36. Operate the AN/URC-92 transceiver and applicable secure voice equipment
37. Inspect fuel equipment compartment starboard (2-17-3Q).
38. Inspect fuel equipment compartment port (2-17-4Q).
39. Activate and adjust the radar.
40. Deactivate radar and HSVL, and acquire and provide information to crew to assist in performing well deck entry with support ship underway.
41. Inspect fuel bay port aft (2-15-2Q).
42. Communicate with personnel aboard other platforms or ashore.
43. Report maintenance discrepancies to engineer or craftmaster.
44. Acquire surface contacts, visually, and provide information to crew.
45. Operate the AN/VRC-43 transceiver and applicable secure voice equipment.
46. Activate and tune the AN/VRC-43 transceiver and applicable secure voice equipment.
47. Activate the attitude heading reference unit (AHRU).
48. Inspect fuel bay port forward (2-3-2Q).
49. Inspect fuel bay starboard forward (2-4-1Q).

50. Activate and tune the AN/ARC-182/AN/ARC-182A transceiver and applicable secure voice equipment.
51. Acquire surf and beach conditions/features, visually, and provide information to crew.
52. Respond/recover from loss of DCU.
53. Enter data to generate a job materials list.
54. Respond/recover from loss of SCU.
55. Activate and tune the AN/URC-92 transceiver and applicable secure voice equipment.
56. Respond/recover from loss of internal craft communications.
57. Respond/recover from loss of GPS.
58. Participate in general premission planning.
59. Deactivate radar and HSVL, and acquire and provide information to crew to assist in performing low speed water-to-land transition, craft in maneuver mode in smooth water and obstacles on beach.
60. Deactivate radar and HSVL, and acquire and provide information to crew to assist in performing water-to-land transition through surf, craft in cruise mode.
61. Deactivate radar and HSVL, and acquire and provide information to crew to assist in performing well deck entry with support ship at anchor.
62. Activate the scan converter unit (SCU).
63. Deactivate radar and HSVL, and acquire and provide information to crew to assist in performing high speed water-to-land transition, craft in cruise mode in smooth water and on clear beach.
64. Operate/monitor the AHRU and provide navigation information to crew.
65. Request and receive information from craftmaster regarding operational issues.
66. Activate the digital converter unit (DCU).
67. Respond/recover from loss of AHRU.
68. Request and receive information from loadmaster regarding port-side visibility (e.g., other craft, surf, beach, lights, etc.).
69. Inspect starboard side frame 15/fantail.
70. Respond/recover from loss of AN/ARC-182/182A transceiver.
71. Acquire and provide information to crew to assist in maintaining heading control over hump speed.
72. Acquire and provide information to crew to assist in performing a well deck departure.
73. Activate radar and HSVL, and acquire and provide information to crew to assist with transition land-to-water into smooth water, at crest of beach.
74. Acquire and provide information to crew to assist in executing lateral translation, underway.

75. Request and receive information from craftmaster or engineer regarding visibility (e.g., other craft, surf, beach, lights, etc.).
76. Maintain crew operating (hour) log.
77. Acquire and provide information to crew to assist in performing a mission departure.
78. Respond/recover from loss of HSVL.
79. Acquire and provide information to crew to assist in performing a departure from land.
80. Inspect below deck spaces.
81. Acquire and provide information to crew to assist transition over hump at critical depth, water depth 8-20 feet.
82. Inspect starboard control cabin.
83. Respond/recover from loss of AN/VRC-92 transceiver.
84. Obtain wind, tide, sea state, and beach conditions from CIC.
85. Acquire and provide information to crew to assist in performing return procedures.
86. Acquire and provide information to crew to assist in maintaining heading control under hump speed.
87. Acquire and provide information to crew to assist transition over hump in shallow water, water depth 1-7 feet.
88. Respond/recover from loss of AN/URC-43 transceiver.
89. Operate/monitor the HSVL and provide navigation information to crew.
90. Inspect starboard superstructure/01 level.
91. Perform walk-around inspection of craft.
92. Maintain deck log.
93. Inspect the port superstructure.
94. Inspect the starboard superstructure.
95. Acquire and provide information to crew to assist in traversing slopes (small hills and sand dunes), craft in maneuvering mode.
96. Acquire and provide information to crew to assist in performing lateral translation on a slope.
97. Inspect cargo deck.
98. Acquire and provide information to crew to assist in backing craft down slope, craft in cruise mode, on slope with bow up-slope.
99. Perform walk-around inspection of craft.
100. Activate the high speed velocity log (HSVL).

101. Acquire and provide information to crew to assist transition over hump in deep water, water depth greater than 20 feet.
102. Create monthly crew operating (hour) reports.
103. Acquire and provide information to crew to assist in positioning craft for loading/unloading, craft in maneuvering mode.
104. Request and receive information from engineer regarding navigation issues.
105. Inspect exterior hull.
106. Request and receive information from loadmaster regarding status of cargo, mechanical systems, or deck operations.
107. Acquire and provide information to crew to assist in operating craft in hullborne mode.
108. Acquire and provide information to crew to assist in performing lateral translation in a hover.
109. Acquire and provide information to crew to assist with lift-off and hover over land.
110. Acquire and provide information to crew to assist with lift-off and hover over water.
111. Acquire and provide information to crew to assist in performing normal stop over water.
112. Acquire and provide information to crew to assist in performing normal stop over land, craft in maneuvering mode.
113. Inspect port side frame 15/fantail.
114. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
115. Obtain cargo weight and number of passengers from loadmaster.
116. Obtain signatures verifying that pre- and postmission checks have been performed.
117. Inspect port superstructure/01 level.
118. Acquire and provide information to crew to assist in coming to low cushion over water, craft stopped and in hover.
119. Inspect port passenger compartment.
120. Acquire and provide information to crew to assist in coming off cushion over water, craft stopped and in hover.
121. Obtain outside temperature from engineer.

NAVIGATOR TASK LIST 2:
LCAC NAVIGATOR OPERATIONAL TASKS
IN DESCENDING ORDER OF
DIFFICULTY TO LEARN

Rank
Order

1. Activate the global positioning system (GPS).
2. Perform navigator duties at night, using night vision equipment.
3. Make navigation decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
4. Perform navigator duties in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
5. Serve as safety officer on deck to assist departure from ship mooring.
6. Inspect fuel bay starboard aft (2-15-1Q).
7. Inspect fuel equipment compartment starboard (2-17-3Q),.
8. Inspect fuel equipment compartment port (2-17-4Q).
9. Operate/monitor the GPS and provide navigation information to crew.
10. Perform navigator duties in heavy weather over water, in daylight, with sea state of 4 or greater.
11. Develop mission plan, using appropriate formulas and collected information, and present plan to craftmaster for review.
12. Order materials and replacement parts through MRMS.
13. Serve as safety officer on deck to assist anchoring craft.
14. Serve as safety officer on deck to assist mooring to a ship at anchor.
15. Inspect fuel bay port aft (2-15-2Q).
16. Serve as safety officer on deck to assist mooring to a pier.
17. Inspect fuel bay port forward (2-3-2Q).
18. Inspect fuel bay starboard forward (2-4-1Q).
19. Serve as safety officer on deck to assist mooring to a buoy.
20. Perform navigator duties over ice.
21. Perform navigator duties during ice breaking operations.
22. Perform navigator duties during cold weather operations.

23. Plot a track with dead reckoning navigation.
24. Prepare a navigation run.
25. Serve as safety officer on deck to assist departure from anchorage.
26. Read, interpret, and update nautical charts.
27. Respond to collision.
28. Enter data to generate a job materials list.
29. Perform navigator duties in high winds over land in daylight.
30. Activate radar and HSVL, and acquire and provide information to crew to assist transition land-to-water into 4-8 feet of surf.
31. Respond to man overboard.
32. Respond/recover from loss of GPS.
33. Respond to a craft deck cargo fire.
34. Abandon craft, craft sinking or fire out of control.
35. Operate/monitor the radar and provide navigation information to crew.
36. Respond to general craft fire.
37. Jettison cargo.
38. Operate the AN/ARC-182/AN/ARC-182A transceiver and applicable secure voice equipment.
39. Inspect below deck spaces.
40. Acquire and provide information to crew to assist in performing turn, underway.
41. Deactivate radar and HSVL, and acquire and provide information to crew to assist in performing well deck entry with support ship underway.
42. Operate the AN/URC-92 transceiver and applicable secure voice equipment.
43. Acquire surf and beach conditions/features, visually, and provide information to crew.
44. Maintain crew operating (hour) log.
45. Activate radar and HSVL, and acquire and provide information to crew to assist with transition land-to-water into smooth water, at crest of beach.
46. Coordinate operational actions with other crew.
47. Operate the AN/VRC-43 transceiver and applicable secure voice equipment.
48. Respond/recover from loss of radar.
49. Respond/recover from loss of DCU.

50. Deactivate radar and HSVL, and acquire and provide information to crew to assist in performing low speed water-to-land transition, craft in maneuver mode in smooth water and obstacles on beach.
51. Acquire surface contacts, visually, and provide information to crew.
52. Respond/recover from loss of SCU.
53. Activate and tune the AN/VRC-43 transceiver and applicable secure voice equipment.
54. Acquire and provide information to crew to assist transition over hump in shallow water, water depth 1-7 feet.
55. Communicate with personnel aboard other platforms or ashore.
56. Report maintenance discrepancies to engineer or craftmaster.
57. Participate in general premission planning.
58. Activate and tune the AN/ARC-182/AN/ARC-182A transceiver and applicable secure voice equipment.
59. Deactivate radar and HSVL, and acquire and provide information to crew to assist in performing well deck entry with support ship at anchor.
60. Deactivate radar and HSVL, and acquire and provide information to crew to assist in performing water-to-land transition through surf, craft in cruise mode.
61. Acquire and provide information to crew to assist transition over hump at critical depth, water depth 8-20 feet.
62. Activate and tune the AN/URC-92 transceiver and applicable secure voice equipment.
63. Acquire and provide information to crew to assist in maintaining heading control over hump speed.
64. Inspect starboard side frame 15/fantail.
65. Deactivate radar and HSVL, and acquire and provide information to crew to assist in performing high speed water-to-land transition, craft in cruise mode in smooth water and on clear beach.
66. Acquire and provide information to crew to assist transition over hump in deep water, water depth greater than 20 feet.
67. Establish and maintain electronic communications, using head sets and microphones.
68. Acquire and provide information to crew to assist in performing a departure from land.
69. Acquire and provide information to crew to assist in executing lateral translation, underway.
70. Respond/recover from loss of AHRU.
71. Create monthly crew operating (hour) reports.
72. Acquire and provide information to crew to assist in performing a well deck departure.
73. Acquire and provide information to crew to assist in performing return procedures.
74. Inspect starboard control cabin.

75. Operate/monitor the AHRU and provide navigation information to crew.
76. Respond/recover from loss of internal craft communications.
77. Acquire and provide information to crew to assist in traversing slopes (small hills and sand dunes), craft in maneuvering mode.
78. Acquire and provide information to crew to assist in positioning craft for loading/unloading, craft in maneuvering mode.
79. Activate and adjust the radar.
80. Activate the attitude heading reference unit (AHRU).
81. Acquire and provide information to crew to assist in performing a mission departure.
82. Respond/recover from loss of AN/ARC-182/182A transceiver.
83. Respond/recover from loss of HSVL.
84. Acquire and provide information to crew to assist in backing craft down slope, craft in cruise mode, on slope with bow up-slope.
85. Acquire and provide information to crew to assist in performing lateral translation on a slope.
86. Inspect port passenger compartment.
87. Inspect port superstructure/01 level.
88. Inspect port side frame 15/fantail.
89. Perform walk-around inspection of craft.
90. Acquire and provide information to crew to assist in maintaining heading control under hump speed.
91. Inspect the port superstructure.
92. Request and receive information from craftmaster regarding operational issues.
93. Respond/recover from loss of AN/URC-43 transceiver.
94. Acquire and provide information to crew to assist with lift-off and hover over land.
95. Respond/recover from loss of AN/VRC-92 transceiver.
96. Inspect starboard superstructure/01 level.
97. Acquire and provide information to crew to assist in performing lateral translation in a hover.
98. Acquire and provide information to crew to assist in operating craft in hullborne mode.
99. Perform walk-around inspection of craft.
100. Acquire and provide information to crew to assist with lift-off and hover over water.
101. Acquire and provide information to crew to assist in performing normal stop over land, craft in maneuvering mode.

102. Inspect exterior hull.
103. Inspect the starboard superstructure.
104. Activate the scan converter unit (SCU).
105. Request and receive information from loadmaster regarding status of cargo, mechanical systems, or deck operations.
106. Request and receive information from loadmaster regarding port-side visibility (e.g., other craft, surf, beach, lights, etc.).
107. Request and receive information from craftmaster or engineer regarding visibility (e.g., other craft, surf, beach, lights, etc.).
108. Operate/monitor the HSVL and provide navigation information to crew.
109. Inspect cargo deck.
110. Acquire and provide information to crew to assist in performing normal stop over water.
111. Maintain deck log.
112. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
113. Request and receive information from engineer regarding navigation issues.
114. Acquire and provide information to crew to assist in coming off cushion over water, craft stopped and in hover.
115. Activate the digital converter unit (DCU).
116. Acquire and provide information to crew to assist in coming to low cushion over water, craft stopped and in hover.
117. Obtain wind, tide, sea state, and beach conditions from CIC.
118. Obtain cargo weight and number of passengers from loadmaster.
119. Obtain signatures verifying that pre- and postmission checks have been performed.
120. Activate the high speed velocity log (HSVL).
121. Obtain outside temperature from engineer.

NAVIGATOR TASK LIST 3:
LCAC NAVIGATOR OPERATIONAL TASKS
IN DESCENDING ORDER OF

IMPORTANCE

Rank
Order

1. Respond to general craft fire.
2. Respond to a craft deck cargo fire.
3. Respond to man overboard.
4. Respond to collision.
5. Abandon craft, craft sinking or fire out of control.
6. Perform navigator duties in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
7. Perform navigator duties at night, using night vision equipment.
8. Activate and adjust the radar.
9. Serve as safety officer on deck to assist mooring to a ship at anchor.
10. Serve as safety officer on deck to assist anchoring craft.
11. Make navigation decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
12. Establish and maintain electronic communications, using head sets and microphones.
13. Activate the attitude heading reference unit (AHRU).
14. Activate the digital converter unit (DCU).
15. Activate the global positioning system (GPS).
16. Serve as safety officer on deck to assist mooring to a pier.
17. Serve as safety officer on deck to assist departure from anchorage.
18. Activate the scan converter unit (SCU).
19. Coordinate operational actions with other crew.
20. Plot a track with dead reckoning navigation.
21. Respond/recover from loss of radar.
22. Develop mission plan, using appropriate formulas and collected information, and present plan to craftmaster for review.
23. Serve as safety officer on deck to assist mooring to a buoy.

24. Request and receive information from loadmaster regarding port-side visibility (e.g., other craft, surf, beach, lights, etc.).
25. Serve as safety officer on deck to assist departure from ship mooring.
26. Prepare a navigation run.
27. Jettison cargo.
28. Communicate with personnel aboard other platforms or ashore.
29. Report maintenance discrepancies to engineer or craftmaster.
30. Respond/recover from loss of internal craft communications.
31. Request and receive information from craftmaster regarding operational issues.
32. Activate and tune the AN/ARC-182/AN/ARC-182A transceiver and applicable secure voice equipment.
33. Acquire surface contacts, visually, and provide information to crew.
34. Activate and tune the AN/VRC-43 transceiver and applicable secure voice equipment.
35. Operate the AN/ARC-182/AN/ARC-182A transceiver and applicable secure voice equipment.
36. Read, interpret, and update nautical charts.
37. Acquire and provide information to crew to assist in performing turn, underway.
38. Perform navigator duties during cold weather operations.
39. Operate the AN/VRC-43 transceiver and applicable secure voice equipment.
40. Operate the AN/URC-92 transceiver and applicable secure voice equipment.
41. Activate and tune the AN/URC-92 transceiver and applicable secure voice equipment.
42. Perform navigator duties in heavy weather over water, in daylight, with sea state of 4 or greater.
43. Perform navigator duties over ice.
44. Operate/monitor the radar and provide navigation information to crew.
45. Deactivate radar and HSVI, and acquire and provide information to crew to assist in performing well deck entry with support ship underway.
46. Respond/recover from loss of DCU.
47. Obtain wind, tide, sea state, and beach conditions from CIC.
48. Respond/recover from loss of SCU.
49. Participate in general premission planning.
50. Acquire surf and beach conditions/features, visually, and provide information to crew.

51. Perform navigator duties during ice breaking operations.
52. Activate the high speed velocity log (HSV L).
53. Operate/monitor the AHRU and provide navigation information to crew.
54. Request and receive information from craftmaster or engineer regarding visibility (e.g., other craft, surf, beach, lights, etc.).
55. Deactivate radar and HSV L, and acquire and provide information to crew to assist in performing water-to-land transition through surf, craft in cruise mode.
56. Operate/monitor the GPS and provide navigation information to crew.
57. Activate radar and HSV L, and acquire and provide information to crew to assist transition land-to-water into 4-8 feet of surf.
58. Deactivate radar and HSV L, and acquire and provide information to crew to assist in performing well deck entry with support ship at anchor.
59. Deactivate radar and HSV L, and acquire and provide information to crew to assist in performing low speed water-to-land transition, craft in maneuver mode in smooth water and obstacles on beach.
60. Deactivate radar and HSV L, and acquire and provide information to crew to assist in performing high speed water-to-land transition, craft in cruise mode in smooth water and on clear beach.
61. Respond/recover from loss of AN/ARC-182/182A transceiver.
62. Perform navigator duties in high winds over land in daylight.
63. Order materials and replacement parts through MRMS.
64. Respond/recover from loss of AHRU.
65. Operate/monitor the HSV L and provide navigation information to crew.
66. Respond/recover from loss of GPS.
67. Inspect starboard side frame 15/fantail.
68. Acquire and provide information to crew to assist in performing a well deck departure.
69. Maintain deck log.
70. Respond/recover from loss of AN/VRC-92 transceiver.
71. Acquire and provide information to crew to assist in maintaining heading control over hump speed.
72. Respond/recover from loss of HSV L.
73. Enter data to generate a job materials list.
74. Respond/recover from loss of AN/URC-43 transceiver.
75. Acquire and provide information to crew to assist in performing a mission departure.
76. Acquire and provide information to crew to assist in maintaining heading control under hump speed.

77. Acquire and provide information to crew to assist in executing lateral translation, underway.
78. Inspect the starboard superstructure.
79. Inspect starboard superstructure/01 level.
80. Perform walk-around inspection of craft.
81. Inspect starboard control cabin.
82. Activate radar and HSVL, and acquire and provide information to crew to assist with transition land-to-water into smooth water, at crest of beach.
83. Acquire and provide information to crew to assist in performing a departure from land.
84. Inspect fuel bay port forward (2-3-2Q).
85. Request and receive information from engineer regarding navigation issues.
86. Acquire and provide information to crew to assist in performing return procedures.
87. Inspect the port superstructure.
88. Inspect fuel bay starboard forward (2-4-1Q).
89. Inspect fuel bay port aft (2-15-2Q).
90. Inspect fuel bay starboard aft (2-15-1Q).
91. Inspect cargo deck.
92. Acquire and provide information to crew to assist transition over hump at critical depth, water depth 8-20 feet.
93. Obtain signatures verifying that pre- and postmission checks have been performed.
94. Maintain crew operating (hour) log.
95. Inspect exterior hull.
96. Inspect fuel equipment compartment starboard (2-17-3Q),.
97. Inspect fuel equipment compartment port (2-17-4Q).
98. Acquire and provide information to crew to assist in traversing slopes (small hills and sand dunes), craft in maneuvering mode.
99. Acquire and provide information to crew to assist in performing lateral translation on a slope.
100. Request and receive information from loadmaster regarding status of cargo, mechanical systems, or deck operations.
101. Acquire and provide information to crew to assist transition over hump in shallow water, water depth 1-7 feet.
102. Perform walk-around inspection of craft.

103. Obtain cargo weight and number of passengers from loadmaster.
104. Inspect below deck spaces.
105. Acquire and provide information to crew to assist in operating craft in hullborne mode.
106. Acquire and provide information to crew to assist in backing craft down slope, craft in cruise mode, on slope with bow up-slope.
107. Acquire and provide information to crew to assist in performing lateral translation in a hover.
108. Acquire and provide information to crew to assist in performing normal stop over water.
109. Acquire and provide information to crew to assist with lift-off and hover over land.
110. Acquire and provide information to crew to assist with lift-off and hover over water.
111. Acquire and provide information to crew to assist in positioning craft for loading/unloading, craft in maneuvering mode.
112. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
113. Create monthly crew operating (hour) reports.
114. Acquire and provide information to crew to assist transition over hump in deep water, water depth greater than 20 feet.
115. Acquire and provide information to crew to assist in performing normal stop over land, craft in maneuvering mode.
116. Inspect port side frame 15/fantail.
117. Inspect port superstructure/01 level.
118. Acquire and provide information to crew to assist in coming to low cushion over water, craft stopped and in hover.
119. Acquire and provide information to crew to assist in coming off cushion over water, craft stopped and in hover.
120. Obtain outside temperature from engineer.
121. Inspect port passenger compartment.

APPENDIX 8.

LCAC LOADMASTER TASKS RANKED IN DESCENDING ORDER OF

- 1) OVERALL CRITICALITY**
- 2) DIFFICULTY TO LEARN**
- 3) IMPORTANCE TO MISSION SUCCESS**

LOADMASTER TASK LIST 1:
LCAC LOADMASTER OPERATIONAL TASKS
IN DESCENDING ORDER OF
OVERALL CRITICALITY

Rank
Order

1. Operate the P-250 pump.
2. Rig the P-250 pump.
3. Calculate cargo weight using appropriate formula.
4. Perform loadmaster duties in heavy weather, over water, in daylight, with sea state of 4 or greater.
5. Abandon craft, craft sinking or fire out of control.
6. Respond to man overboard.
7. Respond to failed tow rig.
8. Respond to a craft deck cargo fire.
9. Rig the craft tow rig to tow an LCAC.
10. Perform loadmaster duties in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
11. Calculate total craft weight using appropriate formula.
12. Rig the craft tow rig to be towed by another LCAC.
13. Rig/operate emergency stern ramp recovery gear.
14. Respond to collision.
15. Respond to a general craft fire.
16. Jettison cargo.
17. Determine the optimum layout for balancing cargo on LCAC deck.
18. Acquire and provide information to crew to assist in performing well deck entry with support ship at anchor.
19. Supervise non-crew personnel in attaching gripes to secure cargo using hostile fire/waritime method.
20. Acquire and provide information to crew to assist in performing well deck entry with support ship underway.
21. Make decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.

22. Perform loadmaster duties over ice.
23. Acquire and provide information to crew to assist in positioning craft for loading/unloading, craft in maneuvering mode.
24. Respond to loose cargo on deck.
25. Assist anchoring craft.
26. Provide safety and technical support to crew responding to equipment casualties.
27. Perform CRRC launch and recovery.
28. Remove the craft tow rig after having been towed.
29. Retrieve the anchor to permit departure from anchorage.
30. Perform loadmaster duties in high winds over land in daylight.
31. Supervise personnel in the performance of loading tasks or other work.
32. Acquire and provide information to crew to assist in backing craft down slope, craft in cruise mode, on slope with bow up-slope.
33. Rig and deploy anchor to assist anchoring craft.
34. Perform loadmaster duties at night, using night vision equipment.
35. Coordinate performance of all checklists.
36. Attach gripes to secure cargo using hostile fire/wartime method.
37. Participate in general premission planning process.
38. Direct loading of cargo by crane method, using hand signals and voice commands.
39. Assist in installation of cold weather kit.
40. Determine the center of balance of a combined load.
41. Create LCAC load plan and submit to craftmaster for review.
42. Supervise non-crew personnel in attaching gripes to secure cargo using peacetime/training method.
43. Serve as line handler to assist mooring to a ship at anchor.
44. Assist departure from anchorage.
45. Serve as line handler to assist mooring to a buoy.
46. Acquire and provide information to crew to assist in performing low speed water-to-land transition, craft in maneuver mode in smooth water and obstacles on beach.
47. Report maintenance discrepancies to maintenance control.
48. Rig/operate emergency hydraulic pump for bow/stern ramp.

49. Request and receive information from craftmaster, engineer or navigator regarding visibility (e.g., other craft, surf, beach, lights, etc.).
50. Direct loading of cargo in a weldeck, using hand signals and voice commands.
51. Remove and secure the craft tow rig after towing.
52. Acquire and provide information to crew to assist in traversing slopes (small hills and sand dunes), craft in maneuvering mode.
53. Direct crew personnel, verbally, to conduct specific tasks.
54. Acquire and provide information to crew to assist in performing lateral translation on a slope.
55. Direct offloading of cargo by crane method, using hand signals and voice commands.
56. Acquire and provide information to crew to assist in performing high speed water-to-land transition, craft in cruise mode in smooth water and on clear beach.
57. Establish and maintain electronic communications, using head sets and microphones.
58. Coordinate operational actions with other crew.
59. Request and receive information from craftmaster regarding operational issues.
60. Determine the required number and location of gripes to secure cargo.
61. Direct non-crew personnel, verbally, to conduct specific tasks.
62. Request and receive information from navigator regarding navigation issues.
63. Acquire and provide information to crew to assist with transition land-to-water into smooth water, at crest of beach.
64. Inspect fuel bay port forward (2-4-2Q).
65. Inspect fuel bay port aft (2-15-2Q).
66. Acquire and provide information to crew to assist transition over hump at critical depth, water depth 8-20 feet.
67. Perform walk-around inspection of craft.
68. Acquire and provide information to crew to assist with lift-off and hover over land.
69. Direct loading of cargo on the beach, using hand signals and voice commands.
70. Perform AAV launch.
71. Inspect port side frame 15/fantail.
72. Maintain and file load plans.
73. Inspect fuel equipment compartment port (2-17-4Q).
74. Acquire and provide information to crew to assist in executing lateral translation, underway.

75. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
76. Perform loadmaster duties during ice breaking operations.
77. Acquire and provide information to crew to assist transition land-to-water into 4-8 feet of surf.
78. Acquire and provide information to crew to assist in performing lateral translation in a hover.
79. Inspect fuel bay starboard aft (2-15-1Q).
80. Inspect fuel equipment compartment starboard (2-17-3Q).
81. Direct offloading of cargo in a welldeck, using hand signals and voice commands.
82. Assist in verification of cold weather systems operation.
83. Direct offloading of cargo on the beach, using hand signals and voice commands.
84. Acquire and provide information to crew to assist transition over hump in deep water, water depth greater than 20 feet.
85. Acquire and provide information to crew to assist in performing water-to-land transition through surf, craft in cruise mode.
86. Inspect fuel bay starboard forward (2-4-1Q).
87. Acquire and provide information to crew to assist in performing turn, underway.
88. Attach gripes to secure cargo using peacetime/training method.
89. Serve as line handler to assist mooring to a pier.
90. Acquire and provide information to crew to assist with lift-off and hover over water.
91. Assist with engine water wash.
92. Inspect cargo deck.
93. Request and receive information from engineer regarding engineering issues.
94. Serve as line handler to assist departure from ship mooring.
95. Inspect starboard side frame 15/fantail.
96. Assist in cold weather shutdown procedures.
97. Inspect starboard superstructure/01 level.
98. Inspect exterior hull.
99. Assist with pressure refueling, craft off cushion, powered up, main engines secured.
100. Assist with pressure defueling.
101. Acquire and provide information to crew to assist in maintaining heading control under hump speed.

102. Acquire and provide information to crew to assist in operating craft in hullborne mode.
103. Assist with craft fresh water wash.
104. Perform walk-around inspection of craft.
105. Acquire and provide information to crew to assist transition over hump in shallow water, water depth 1-7 feet.
106. Acquire and provide information to crew to assist in performing normal stop over water.
107. Perform loadmaster duties during cold weather operations.
108. Determine the center of balance of palletized cargo or ISO container.
109. Acquire and provide information to crew to assist in coming off cushion over water, craft stopped and in hover.
110. Create bow-heavy load plan for long distance missions.
111. Acquire and provide information to crew to assist in performing normal stop over land, craft in maneuvering mode.
112. Rig/unrig stern ramp chains for AAV launch.
113. Determine the center of balance of a single axle vehicle.
114. Inspect port superstructure 01 level.
115. Erect/stow port mast light.
116. Inspect below deck spaces.
117. Inspect the starboard superstructure.
118. Communicate with personnel aboard other platforms or ashore.
119. Determine the center of balance of a tandem axle vehicle.
120. Inspect the port superstructure.
121. Assist with gravity refueling, craft off cushion, no power available.
122. Assist in cold weather start operation.
123. Acquire and provide information to crew to assist in coming to low cushion over water, craft stopped and in hover.
124. Receive and evaluate load plan submitted by non-crew personnel.
125. Acquire and provide information to crew to assist in maintaining heading control over hump speed.
126. Inspect starboard control cabin.
127. Inspect port passenger compartment.

LOADMASTER TASK LIST 2:
LCAC LOADMASTER OPERATIONAL TASKS
IN DESCENDING ORDER OF
DIFFICULTY TO LEARN

Rank
Order

1. Calculate cargo weight using appropriate formula.
2. Operate the P-250 pump.
3. Rig the P-250 pump.
4. Create LCAC load plan and submit to craftmaster for review.
5. Determine the optimum layout for balancing cargo on LCAC deck.
6. Determine the center of balance of a combined load.
7. Calculate total craft weight using appropriate formula.
8. Assist in installation of cold weather kit.
9. Perform loadmaster duties in heavy weather, over water, in daylight, with sea state of 4 or greater.
10. Determine the center of balance of palletized cargo or ISO container.
11. Receive and evaluate load plan submitted by non-crew personnel.
12. Maintain and file load plans.
13. Determine the center of balance of a single axle vehicle.
14. Determine the center of balance of a tandem axle vehicle.
15. Acquire and provide information to crew to assist in performing well deck entry with support ship at anchor.
16. Make decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
17. Serve as line handler to assist mooring to a buoy.
18. Participate in general premission planning process.
19. Perform loadmaster duties in high winds over land in daylight.
20. Acquire and provide information to crew to assist in performing well deck entry with support ship underway.
21. Acquire and provide information to crew to assist in positioning craft for loading/unloading, craft in maneuvering mode.
22. Respond to failed tow rig.

23. Abandon craft, craft sinking or fire out of control.
24. Respond to man overboard.
25. Rig/operate emergency stern ramp recovery gear.
26. Rig the craft tow rig to tow an LCAC.
27. Perform loadmaster duties in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
28. Acquire and provide information to crew to assist transition over hump at critical depth, water depth 8-20 feet.
29. Supervise non-crew personnel in attaching gripes to secure cargo using hostile fire/wartime method.
30. Acquire and provide information to crew to assist in backing craft down slope, craft in cruise mode, on slope with bow up-slope.
31. Perform CRRC launch and recovery.
32. Remove the craft tow rig after having been towed.
33. Assist with engine water wash.
34. Assist anchoring craft.
35. Retrieve the anchor to permit departure from anchorage.
36. Rig the craft tow rig to be towed by another LCAC.
37. Direct loading of cargo by crane method, using hand signals and voice commands.
38. Provide safety and technical support to crew responding to equipment casualties.
39. Respond to collision.
40. Acquire and provide information to crew to assist in traversing slopes (small hills and sand dunes), craft in maneuvering mode.
41. Acquire and provide information to crew to assist in performing high speed water-to-land transition, craft in cruise mode in smooth water and on clear beach.
42. Respond to loose cargo on deck.
43. Respond to a craft deck cargo fire.
44. Acquire and provide information to crew to assist in performing lateral translation on a slope.
45. Determine the required number and location of gripes to secure cargo.
46. Acquire and provide information to crew to assist in performing low speed water-to-land transition, craft in maneuver mode in smooth water and obstacles on beach.
47. Respond to a general craft fire.

48. Assist in cold weather shutdown procedures.
49. Assist in verification of cold weather systems operation.
50. Jettison cargo.
51. Perform AAV launch.
52. Rig and deploy anchor to assist anchoring craft.
53. Supervise personnel in the performance of loading tasks or other work.
54. Perform loadmaster duties at night, using night vision equipment.
55. Acquire and provide information to crew to assist in coming off cushion over water, craft stopped and in hover.
56. Direct offloading of cargo by crane method, using hand signals and voice commands.
57. Acquire and provide information to crew to assist transition land-to-water into 4-8 feet of surf.
58. Acquire and provide information to crew to assist with lift-off and hover over land.
59. Acquire and provide information to crew to assist in executing lateral translation, underway.
60. Acquire and provide information to crew to assist in performing normal stop over land, craft in maneuvering mode.
61. Coordinate performance of all checklists.
62. Perform loadmaster duties over ice.
63. Assist in cold weather start operation.
64. Direct loading of cargo in a welldeck, using hand signals and voice commands.
65. Acquire and provide information to crew to assist in performing normal stop over water.
66. Assist with pressure defueling.
67. Acquire and provide information to crew to assist transition over hump in deep water, water depth greater than 20 feet.
68. Attach gripes to secure cargo using hostile fire/wartime method.
69. Acquire and provide information to crew to assist in maintaining heading control under hump speed.
70. Acquire and provide information to crew to assist in performing water-to-land transition through surf, craft in cruise mode.
71. Assist departure from anchorage.
72. Rig/operate emergency hydraulic pump for bow/stern ramp.
73. Inspect fuel bay port forward (2-4-2Q).
74. Inspect fuel bay port aft (2-15-2Q).

75. Direct loading of cargo on the beach, using hand signals and voice commands.
76. Serve as line handler to assist mooring to a ship at anchor.
77. Serve as line handler to assist mooring to a pier.
78. Remove and secure the craft tow rig after towing.
79. Acquire and provide information to crew to assist in performing lateral translation in a hover.
80. Request and receive information from engineer regarding engineering issues.
81. Coordinate operational actions with other crew.
82. Direct crew personnel, verbally, to conduct specific tasks.
83. Communicate with personnel aboard other platforms or ashore.
84. Inspect fuel equipment compartment port (2-17-4Q).
85. Inspect fuel equipment compartment starboard (2-17-3Q).
86. Acquire and provide information to crew to assist with lift-off and hover over water.
87. Acquire and provide information to crew to assist in performing turn, underway.
88. Supervise non-crew personnel in attaching gripes to secure cargo using peacetime/training method.
89. Direct non-crew personnel, verbally, to conduct specific tasks.
90. Perform loadmaster duties during cold weather operations.
91. Acquire and provide information to crew to assist in operating craft in hullborne mode.
92. Assist with pressure refueling, craft off cushion, powered up, main engines secured.
93. Acquire and provide information to crew to assist transition over hump in shallow water, water depth 1-7 feet.
94. Inspect fuel bay starboard aft (2-15-1Q).
95. Acquire and provide information to crew to assist with transition land-to-water into smooth water, at crest of beach.
96. Direct offloading of cargo on the beach, using hand signals and voice commands.
97. Acquire and provide information to crew to assist in coming to low cushion over water, craft stopped and in hover.
98. Direct offloading of cargo in a welldeck, using hand signals and voice commands.
99. Request and receive information from navigator regarding navigation issues.
100. Inspect fuel bay starboard forward (2-4-1Q).
101. Report maintenance discrepancies to maintenance control.

102. Serve as line handler to assist departure from ship mooring.
103. Request and receive information from craftmaster, engineer or navigator regarding visibility (e.g., other craft, surf, beach, lights, etc.).
104. Request and receive information from craftmaster regarding operational issues.
105. Erect/stow port mast light.
106. Assist with gravity refueling, craft off cushion, no power available.
107. Inspect port side frame 15/fantail.
108. Acquire and provide information to crew to assist in maintaining heading control over hump speed.
109. Establish and maintain electronic communications, using head sets and microphones.
110. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
111. Perform loadmaster duties during ice breaking operations.
112. Rig/unrig stern ramp chains for AAV launch.
113. Inspect exterior hull.
114. Create bow-heavy load plan for long distance missions.
115. Inspect the starboard superstructure.
116. Attach gripes to secure cargo using peacetime/training method.
117. Perform walk-around inspection of craft.
118. Inspect starboard side frame 15/fantail.
119. Inspect cargo deck.
120. Inspect starboard superstructure/01 level.
121. Assist with craft fresh water wash.
122. Inspect the port superstructure.
123. Perform walk-around inspection of craft.
124. Inspect port superstructure 01 level.
125. Inspect below deck spaces.
126. Inspect port passenger compartment.
127. Inspect starboard control cabin.

LOADMASTER TASK LIST 3:
LCAC LOADMASTER OPERATIONAL TASKS
IN DESCENDING ORDER OF
IMPORTANCE

Rank
Order

1. Respond to a craft deck cargo fire.
2. Abandon craft, craft sinking or fire out of control.
3. Respond to a general craft fire.
4. Respond to failed tow rig.
5. Respond to man overboard.
6. Jettison cargo.
7. Respond to collision.
8. Rig the craft tow rig to be towed by another LCAC.
9. Perform loadmaster duties over ice.
10. Rig the craft tow rig to tow an LCAC.
11. Perform loadmaster duties in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
12. Operate the P-250 pump.
13. Rig/operate emergency stern ramp recovery gear.
14. Establish and maintain electronic communications, using head sets and microphones.
15. Respond to loose cargo on deck.
16. Perform loadmaster duties in heavy weather, over water, in daylight, with sea state of 4 or greater.
17. Perform walk-around inspection of craft.
18. Request and receive information from craftmaster, engineer or navigator regarding visibility (e.g., other craft, surf, beach, lights, etc.).
19. Report maintenance discrepancies to maintenance control.
20. Supervise personnel in the performance of loading tasks or other work.
21. Supervise non-crew personnel in attaching gripes to secure cargo using hostile fire/wartime method.
22. Request and receive information from craftmaster regarding operational issues.

23. Supervise non-crew personnel in attaching gripes to secure cargo using peacetime/training method.
24. Rig the P-250 pump.
25. Serve as line handler to assist mooring to a ship at anchor.
26. Attach gripes to secure cargo using hostile fire/warime method.
27. Assist anchoring craft.
28. Rig and deploy anchor to assist anchoring craft.
29. Acquire and provide information to crew to assist in performing well deck entry with support ship underway.
30. Request and receive information from navigator regarding navigation issues.
31. Request and receive information from deck mechanic regarding status of cargo, mechanical systems, or deck operations.
32. Provide safety and technical support to crew responding to equipment casualties.
33. Perform loadmaster duties at night, using night vision equipment.
34. Perform loadmaster duties during ice breaking operations.
35. Assist departure from anchorage.
36. Inspect port side frame 15/fantail.
37. Attach gripes to secure cargo using peacetime/training method.
38. Coordinate performance of all checklists.
39. Acquire and provide information to crew to assist in positioning craft for loading/unloading, craft in maneuvering mode.
40. Perform CRRC launch and recovery.
41. Direct crew personnel, verbally, to conduct specific tasks.
42. Retrieve the anchor to permit departure from anchorage.
43. Acquire and provide information to crew to assist in performing well deck entry with support ship at anchor.
44. Remove and secure the craft tow rig after towing.
45. Rig/operate emergency hydraulic pump for bow/stern ramp.
46. Acquire and provide information to crew to assist with transition land-to-water into smooth water, at crest of beach.
47. Remove the craft tow rig after having been towed.
48. Inspect cargo deck.

49. Direct non-crew personnel, verbally, to conduct specific tasks.
50. Coordinate operational actions with other crew.
51. Direct loading of cargo in a welldeck, using hand signals and voice commands.
52. Inspect below deck spaces.
53. Perform walk-around inspection of craft.
54. Acquire and provide information to crew to assist in backing craft down slope, craft in cruise mode, on slope with bow up-slope.
55. Make decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
56. Inspect starboard superstructure/01 level.
57. Inspect port superstructure 01 level.
58. Perform loadmaster duties in high winds over land in daylight.
59. Inspect starboard side frame 15/fantail.
60. Inspect fuel bay port forward (2-4-2Q).
61. Inspect fuel bay port aft (2-15-2Q).
62. Direct offloading of cargo in a welldeck, using hand signals and voice commands.
63. Inspect fuel bay starboard forward (2-4-1Q).
64. Inspect fuel bay starboard aft (2-15-1Q).
65. Assist with craft fresh water wash.
66. Direct loading of cargo on the beach, using hand signals and voice commands.
67. Direct offloading of cargo on the beach, using hand signals and voice commands.
68. Acquire and provide information to crew to assist in performing low speed water-to-land transition, craft in maneuver mode in smooth water and obstacles on beach.
69. Inspect fuel equipment compartment port (2-17-4Q).
70. Direct loading of cargo by crane method, using hand signals and voice commands.
71. Direct offloading of cargo by crane method, using hand signals and voice commands.
72. Inspect fuel equipment compartment starboard (2-17-3Q).
73. Inspect exterior hull.
74. Calculate cargo weight using appropriate formula.
75. Acquire and provide information to crew to assist in performing lateral translation in a hover.

76. Acquire and provide information to crew to assist in performing lateral translation on a slope.
77. Serve as line handler to assist departure from ship mooring.
78. Calculate total craft weight using appropriate formula.
79. Determine the required number and location of gripes to secure cargo.
80. Acquire and provide information to crew to assist in performing turn, underway.
81. Acquire and provide information to crew to assist with lift-off and hover over land.
82. Acquire and provide information to crew to assist in traversing slopes (small hills and sand dunes), craft in maneuvering mode.
83. Serve as line handler to assist mooring to a pier.
84. Acquire and provide information to crew to assist with lift-off and hover over water.
85. Acquire and provide information to crew to assist in executing lateral translation, underway.
86. Acquire and provide information to crew to assist in performing high speed water-to-land transition, craft in cruise mode in smooth water and on clear beach.
87. Participate in general premission planning process.
88. Serve as line handler to assist mooring to a buoy.
89. Acquire and provide information to crew to assist transition over hump in deep water, water depth greater than 20 feet.
90. Acquire and provide information to crew to assist in performing water-to-land transition through surf, craft in cruise mode.
91. Perform AAV launch.
92. Assist in verification of cold weather systems operation.
93. Inspect the port superstructure.
94. Acquire and provide information to crew to assist transition land-to-water into 4-8 feet of surf.
95. Rig/unrig stern ramp chains for AAV launch.
96. Request and receive information from engineer regarding engineering issues.
97. Create bow-heavy load plan for long distance missions.
98. Inspect the starboard superstructure.
99. Assist with pressure refueling, craft off cushion, powered up, main engines secured.
100. Perform loadmaster duties during cold weather operations.
101. Acquire and provide information to crew to assist transition over hump at critical depth, water depth 8-20 feet.
102. Determine the optimum layout for balancing cargo on LCAC deck.

103. Acquire and provide information to crew to assist in operating craft in hullborne mode.
104. Erect/stow port mast light.
105. Acquire and provide information to crew to assist transition over hump in shallow water, water depth 1-7 feet.
106. Assist in cold weather shutdown procedures.
107. Acquire and provide information to crew to assist in maintaining heading control under hump speed.
108. Assist with pressure defuelling.
109. Assist in installation of cold weather kit.
110. Acquire and provide information to crew to assist in performing normal stop over water.
111. Assist with gravity refueling, craft off cushion, no power available.
112. Assist with engine water wash.
113. Communicate with personnel aboard other platforms or ashore.
114. Acquire and provide information to crew to assist in maintaining heading control over hump speed.
115. Acquire and provide information to crew to assist in coming off cushion over water, craft stopped and in hover.
116. Acquire and provide information to crew to assist in coming to low cushion over water, craft stopped and in hover.
117. Acquire and provide information to crew to assist in performing normal stop over land, craft in maneuvering mode.
118. Determine the center of balance of a combined load.
119. Maintain and file load plans.
120. Assist in cold weather start operation.
121. Inspect starboard control cabin.
122. Create LCAC load plan and submit to craftmaster for review.
123. Inspect port passenger compartment.
124. Determine the center of balance of a single axle vehicle.
125. Determine the center of balance of palletized cargo or ISO container.
126. Determine the center of balance of a tandem axle vehicle.
127. Receive and evaluate load plan submitted by non-crew personnel.

APPENDIX 9.

LCAC DECK MECHANIC TASKS RANKED IN DESCENDING ORDER OF

- 1) OVERALL CRITICALITY**
- 2) DIFFICULTY TO LEARN**
- 3) IMPORTANCE TO MISSION SUCCESS**

DECK MECHANIC TASK LIST 1:

**LCAC DECK MECHANIC OPERATIONAL TASKS
IN DESCENDING ORDER OF**

OVERALL CRITICALITY

**Rank
Order**

1. Diagnose equipment problems, faults, and casualties.
2. Assist the engineer in recovering from loss of lift.
3. Assist the engineer in recovering from loss of rudder control either hydraulic or electrical problem.
4. Assist the engineer in recovering from loss of bow thruster control.
5. Assist the engineer in recovering from loss of main engine fuel pressure.
6. Assist the engineer in recovering from loss of main engine.
7. Make decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
8. Perform port side lookout duties, in relief of loadmaster, as necessary (over water).
9. Request and receive information from engineer regarding power plant or other engineering issues.
10. Assist the engineer in recovering from main engine low lube oil pressure.
11. Assist the engineer in recovering from loss of APU fuel pressure.
12. Assist the engineer in recovering from loss of propellor control.
13. Assist the engineer in recovering from main engine high EGT.
14. Assist the engineer in checking lube oil chip on detectors.
15. Assist the engineer in recovering from APU engine surge/stall.
16. Perform deck engineer job at night.
17. Perform port side lookout duties, in relief of loadmaster, as necessary (over land).
18. Respond to craft deck cargo fire.
19. Assist the engineer in recovering from loss of APU.
20. Assist the engineer in recovering from transmission low lube oil pressure condition.
21. Perform deck engineer job in heavy weather, over water, in daylight, with sea state of 4 or greater.
22. Control bow thruster using local control valves when necessary.
23. Assist with engine water wash.

24. Assist the engineer in recovering from main engine high lube oil temperature.
25. Assist the engineer in recovering from main engine surge/install.
26. Respond to general craft fire.
27. Reset engineering-related circuit breakers.
28. Assist the engineer in recovering from APU high EGT condition.
29. Align bow thruster/cushion vane hydraulics for cross connection.
30. Assist the engineer in recovering from APU low lube oil pressure condition.
31. Assist the engineer in recovering from APU high lube oil temperature condition.
32. Perform below deck craft inspection after a collision.
33. Align main engine fuel feed system for cross connection.
34. Assist the engineer in recovering from transmission high lube oil temperature condition.
35. Abandon craft, craft sinking or fire out of control.
36. Align hydraulic system (prop & rudder) for cross connection.
37. Serve as linehandler when towing another craft.
38. Assist the loadmaster in anchoring and weighing anchor.
39. Assist in starting the main engines by warning all personnel on deck, giving clearance to start, checking lube oil valve alignments, and by observing normal operation of the engine.
40. Perform deck engineer job in high winds over land in daylight.
41. Serve as linehandler when being towed by another craft.
42. Assist the craftmaster in checking normal operation of craft control systems such as the rudders, propellers, and bow thrusters.
43. Inspect fuel bay port aft (2-15-2Q).
44. Inspect fuel bay starboard aft (2-15-1Q).
45. Inspect fuel equipment compartment port (2-17-4Q).
46. Perform leak checks on the lubrication, hydraulic, and fuel systems.
47. Inform the engineer of discrepancies discovered during PMS and/or operation.
48. Respond to man overboard.
49. Inspect fuel equipment compartment starboard (2-17-3Q).
50. Direct/request crew personnel, verbally, to conduct specific tasks.
51. Inspect fuel bay port forward (2-4-2Q).

52. Inspect fuel bay starboard forward (2-4-1Q).
53. Align APU fuel feed system for cross connection.
54. Assist the engineer in recovering from blow-in door opening.
55. Ensure that all tools, materials, and parts normally carried onboard are available.
56. Prepare materials not normally carried onboard that are needed for the mission.
57. Perform deck engineer job in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
58. Serve as linehandler to assist mooring to a ship at anchor.
59. Inspect below deck spaces.
60. Respond to loss of communications.
61. Assist the engineer in recovering from transmission and propeller lube systems low reservoir.
62. Serve as linehandler to assist mooring to a buoy.
63. Serve as linehandler in departing from mooring.
64. Perform emergency repair to skirt system as needed.
65. Serve as linehandler to assist mooring to a pier.
66. Perform inventory of tools onboard.
67. Perform deck engineer job during ice breaking operations.
68. Assist crew personnel with maintenance of logs and preparation of reports.
69. Coordinate performance of all checklists.
70. Perform inventory of spare parts maintained onboard.
71. Assist the engineer in defueling.
72. Direct/request non-crew personnel, verbally, to perform specific tasks.
73. Request and receive information from craftmaster regarding operational issues.
74. Assist the engineer in pressure refueling on ship or on shore.
75. Perform walk-around inspection of craft.
76. Assist in securing cargo on deck.
77. Assist in installation of cold weather kit.
78. Inspect starboard control cabin.
79. Inspect starboard side frame 15/fantail.
80. Inspect port side frame 15/fantail.

81. Supervise personnel in the performance of tasks.
82. Jettison cargo.
83. Perform deck engineer job over ice.
84. Establish and maintain electronic communications, using head sets and microphones.
85. Perform inventory of PMS materials onboard.
86. Perform "clear and bright" test on fuel.
87. Assist with AAV launch.
88. Assist in securing power on the craft.
89. Participate in general premission planning process.
90. Assist in cold weather start operation.
91. Assist in gravity refueling, craft off cushion, no power available.
92. Assist in starting the APU by observing normal operation while on deck and by warning all other personnel on deck.
93. Assist loadmaster with rigging/unrigging stern ramp chains for AAV launch.
94. Assist with CRRC launch and recovery.
95. Inspect the starboard superstructure.
96. Assist in verification of cold weather systems operation.
97. Assist in main engine shutdown.
98. Inspect the port superstructure.
99. Assist in APU shutdown.
100. Request and receive information from navigator regarding navigation issues.
101. Request and receive information from loadmaster regarding status of cargo.
102. Inspect cargo deck.
103. Raise ramps using portable hydraulic pump.
104. Assist in cold weather shutdown procedures.
105. Inspect exterior hull.
106. Inspect port superstructure 01 level.
107. Inspect starboard superstructure/01 level.
108. Attach/disconnect power cable to apply/disconnect external power.
109. Perform inventory of reference publications maintained onboard.

- 110. Assist with craft fresh water wash.**
- 111. Perform raising and lowering of the ramps, as directed.**
- 112. Inspect port passenger compartment.**
- 113. Refill water wash tank with distilled water.**

DECK MECHANIC TASK LIST 2:
LCAC DECK MECHANIC OPERATIONAL TASKS
IN DESCENDING ORDER OF
DIFFICULTY TO LEARN

**Rank
Order**

1. Diagnose equipment problems, faults, and casualties.
2. Assist the engineer in recovering from loss of lift.
3. Assist the engineer in recovering from loss of rudder control either hydraulic or electrical problem.
4. Assist the engineer in recovering from loss of bow thruster control.
5. Perform port side lookout duties, in relief of loadmaster, as necessary (over water).
6. Perform deck engineer job in heavy weather, over water, in daylight, with sea state of 4 or greater.
7. Make decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
8. Assist the engineer in recovering from main engine high EGT.
9. Perform port side lookout duties, in relief of loadmaster, as necessary (over land).
10. Assist the engineer in recovering from loss of main engine fuel pressure.
11. Assist crew personnel with maintenance of logs and preparation of reports.
12. Assist the engineer in recovering from loss of propellor control.
13. Assist the engineer in recovering from loss of main engine.
14. Control bow thruster using local control valves when necessary.
15. Assist the loadmaster in anchoring and weighing anchor.
16. Serve as linehandler to assist mooring to a ship at anchor.
17. Assist the engineer in recovering from APU engine surge/stall.
18. Assist the engineer in recovering from main engine surge/install.
19. Serve as linehandler when towing another craft.
20. Serve as linehandler when being towed by another craft.
21. Assist the engineer in recovering from main engine high lube oil temperature.
22. Assist the engineer in recovering from main engine low lube oil pressure.
23. Assist the engineer in recovering from APU high EGT condition.

24. Assist the engineer in recovering from loss of APU.
25. Assist the engineer in recovering from loss of APU fuel pressure.
26. Assist the engineer in recovering from APU high lube oil temperature condition.
27. Perform deck engineer job at night.
28. Serve as linehandler in departing from mooring.
29. Reset engineering-related circuit breakers.
30. Serve as linehandler to assist mooring to a buoy.
31. Assist the engineer in checking lube oil chip on detectors.
32. Assist the engineer in recovering from APU low lube oil pressure condition.
33. Align bow thruster/cushion vane hydraulics for cross connection.
34. Serve as linehandler to assist mooring to a pier.
35. Assist the engineer in recovering from transmission low lube oil pressure condition.
36. Assist the engineer in recovering from transmission high lube oil temperature condition.
37. Assist with engine water wash.
38. Align main engine fuel feed system for cross connection.
39. Align hydraulic system (prop & rudder) for cross connection.
40. Perform deck engineer job in high winds over land in daylight.
41. Perform emergency repair to skirt system as needed.
42. Request and receive information from engineer regarding power plant or other engineering issues.
43. Assist with AAV launch.
44. Assist in installation of cold weather kit.
45. Respond to craft deck cargo fire.
46. Perform deck engineer job over ice.
47. Respond to general craft fire.
48. Direct/request crew personnel, verbally, to conduct specific tasks.
49. Perform below deck craft inspection after a collision.
50. Perform deck engineer job during ice breaking operations.
51. Assist loadmaster with rigging/unrigging stern ramp chains for AAV launch.

52. Perform deck engineer job in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
53. Abandon craft, craft sinking or fire out of control.
54. Assist with CRRC launch and recovery.
55. Assist the craftmaster in checking normal operation of craft control systems such as the rudders, propellers, and bow thrusters.
56. Align APU fuel feed system for cross connection.
57. Coordinate performance of all checklists.
58. Inspect below deck spaces.
59. Inspect fuel bay port aft (2-15-2Q).
60. Inspect fuel bay starboard aft (2-15-1Q).
61. Inspect fuel bay port forward (2-4-2Q).
62. Inspect fuel bay starboard forward (2-4-1Q).
63. Inspect fuel equipment compartment starboard (2-17-3Q).
64. Inspect fuel equipment compartment port (2-17-4Q).
65. Perform inventory of spare parts maintained onboard.
66. Respond to loss of communications.
67. Prepare materials not normally carried onboard that are needed for the mission.
68. Assist in starting the main engines by warning all personnel on deck, giving clearance to start, checking lube oil valve alignments, and by observing normal operation of the engine.
69. Inform the engineer of discrepancies discovered during PMS and/or operation.
70. Assist the engineer in defueling.
71. Direct/request non-crew personnel, verbally, to perform specific tasks.
72. Respond to man overboard.
73. Assist in securing power on the craft.
74. Assist the engineer in recovering from blow-in door opening.
75. Assist in securing cargo on deck.
76. Jettison cargo.
77. Perform leak checks on the lubrication, hydraulic, and fuel systems.
78. Inspect starboard control cabin.
79. Supervise personnel in the performance of tasks.

80. Perform inventory of tools onboard.
81. Assist in gravity refueling, craft off cushion, no power available.
82. Assist the engineer in pressure refueling on ship or on shore.
83. Participate in general premission planning process.
84. Inspect the starboard superstructure.
85. Perform inventory of PMS materials onboard.
86. Perform inventory of reference publications maintained onboard.
87. Assist in cold weather start operation.
88. Ensure that all tools, materials, and parts normally carried onboard are available.
89. Request and receive information from navigator regarding navigation issues.
90. Inspect starboard side frame 15/fantail.
91. Perform walk-around inspection of craft.
92. Perform "clear and bright" test on fuel.
93. Request and receive information from craftmaster regarding operational issues.
94. Inspect port side frame 15/fantail.
95. Inspect the port superstructure.
96. Assist the engineer in recovering from transmission and propeller lube systems low reservoir.
97. Assist in starting the APU by observing normal operation while on deck and by warning all other personnel on deck.
98. Inspect cargo deck.
99. Assist in main engine shutdown.
100. Raise ramps using portable hydraulic pump.
101. Assist in verification of cold weather systems operation.
102. Inspect starboard superstructure/01 level.
103. Inspect port superstructure 01 level.
104. Request and receive information from loadmaster regarding status of cargo.
105. Inspect exterior hull.
106. Assist in cold weather shutdown procedures.
107. Establish and maintain electronic communications, using head sets and microphones.
108. Inspect port passenger compartment.

- 109. Assist in APU shutdown.
- 110. Attach/disconnect power cable to apply/disconnect external power.
- 111. Assist with craft fresh water wash.
- 112. Perform raising and lowering of the ramps, as directed.
- 113. Refill water wash tank with distilled water.

DECK MECHANIC TASK LIST 3:

**LCAC DECK MECHANIC OPERATIONAL TASKS
IN DESCENDING ORDER OF**

IMPORTANCE

Rank
Order

1. Request and receive information from engineer regarding power plant or other engineering issues.
2. Respond to craft deck cargo fire.
3. Diagnose equipment problems, faults, and casualties.
4. Respond to general craft fire.
5. Assist in starting the main engines by warning all personnel on deck, giving clearance to start, checking lube oil valve alignments, and by observing normal operation of the engine.
6. Assist the engineer in recovering from loss of main engine fuel pressure.
7. Assist the engineer in checking lube oil chip on detectors.
8. Perform below deck craft inspection after a collision.
9. Abandon craft, craft sinking or fire out of control.
10. Assist the engineer in recovering from loss of APU fuel pressure.
11. Perform deck engineer job at night.
12. Ensure that all tools, materials, and parts normally carried onboard are available.
13. Assist the engineer in recovering from main engine low lube oil pressure.
14. Assist the engineer in recovering from loss of bow thruster control.
15. Assist the engineer in recovering from loss of lift.
16. Assist the engineer in recovering from transmission and propeller lube systems low reservoir.
17. Perform leak checks on the lubrication, hydraulic, and fuel systems.
18. Inform the engineer of discrepancies discovered during PMS and/or operation.
19. Assist the engineer in recovering from loss of main engine.
20. Respond to man overboard.
21. Inspect fuel equipment compartment port (2-17-4Q).
22. Assist the engineer in recovering from loss of rudder control either hydraulic or electrical problem.
23. Assist the engineer in recovering from loss of APU.

24. Assist with engine water wash.
25. Assist the engineer in recovering from APU engine surge/stall.
26. Inspect fuel equipment compartment starboard (2-17-3Q).
27. Assist the engineer in recovering from blow-in door opening.
28. Assist the craftmaster in checking normal operation of craft control systems such as the rudders, propellers, and bow thrusters.
29. Assist the engineer in recovering from loss of propellor control.
30. Reset engineering-related circuit breakers.
31. Inspect fuel bay port aft (2-15-2Q).
32. Inspect fuel bay starboard aft (2-15-1Q).
33. Make decisions, independently, to deviate from the established plan or procedures, based on conditions and available information.
34. Assist the engineer in recovering from transmission low lube oil pressure condition.
35. Assist the engineer in recovering from main engine high lube oil temperature.
36. Inspect fuel bay port forward (2-4-2Q).
37. Inspect fuel bay starboard forward (2-4-1Q).
38. Establish and maintain electronic communications, using head sets and microphones.
39. Align bow thruster/cushion vane hydraulics for cross connection.
40. Assist the engineer in recovering from APU low lube oil pressure condition.
41. Assist the engineer in recovering from APU high EGT condition.
42. Align hydraulic system (prop & rudder) for cross connection.
43. Assist the engineer in recovering from main engine surge/install.
44. Perform port side lookout duties, in relief of loadmaster, as necessary (over water).
45. Prepare materials not normally carried onboard that are needed for the mission.
46. Assist the engineer in recovering from main engine high EGT.
47. Assist the engineer in recovering from APU high lube oil temperature condition.
48. Align APU fuel feed system for cross connection.
49. Control bow thruster using local control valves when necessary.
50. Direct/request crew personnel, verbally, to conduct specific tasks.
51. Perform port side lookout duties, in relief of loadmaster, as necessary (over land).

52. Align main engine fuel feed system for cross connection.
53. Perform deck engineer job in high winds over land in daylight.
54. Perform inventory of tools onboard.
55. Assist the engineer in recovering from transmission high lube oil temperature condition.
56. Respond to loss of communications.
57. Request and receive information from craftmaster regarding operational issues.
58. Inspect below deck spaces.
59. Perform deck engineer job in heavy weather, over water, in daylight, with sea state of 4 or greater.
60. Perform deck engineer job during ice breaking operations.
61. Assist the engineer in pressure refueling on ship or on shore.
62. Perform deck engineer job in low visibility, craft in normal operational mode, visibility approximately 1,000 yards.
63. Serve as linehandler when towing another craft.
64. Inspect port side frame 15/fantail.
65. Perform walk-around inspection of craft.
66. Assist the engineer in defueling.
67. Inspect starboard side frame 15/fantail.
68. Perform inventory of spare parts maintained onboard.
69. Assist the loadmaster in anchoring and weighing anchor.
70. Assist in starting the APU by observing normal operation while on deck and by warning all other personnel on deck.
71. Direct/request non-crew personnel, verbally, to perform specific tasks.
72. Assist in cold weather start operation.
73. Serve as linehandler when being towed by another craft.
74. Assist in APU shutdown.
75. Coordinate performance of all checklists.
76. Perform "clear and bright" test on fuel.
77. Assist in securing cargo on deck.
78. Assist in verification of cold weather systems operation.
79. Perform inventory of PMS materials onboard.

80. Inspect starboard control cabin.
81. Supervise personnel in the performance of tasks.
82. Assist in cold weather shutdown procedures.
83. Assist in gravity refueling, craft off cushion, no power available.
84. Jettison cargo.
85. Request and receive information from loadmaster regarding status of cargo.
86. Perform deck engineer job over ice.
87. Participate in general premission planning process.
88. Attach/disconnect power cable to apply/disconnect external power.
89. Assist in main engine shutdown.
90. Assist in securing power on the craft.
91. Perform emergency repair to skirt system as needed.
92. Inspect the starboard superstructure.
93. Inspect the port superstructure.
94. Serve as linehandler to assist mooring to a buoy.
95. Inspect port superstructure 01 level.
96. Inspect cargo deck.
97. Inspect starboard superstructure/01 level.
98. Serve as linehandler to assist mooring to a pier.
99. Serve as linehandler in departing from mooring.
100. Raise ramps using portable hydraulic pump.
101. Inspect exterior hull.
102. Assist in installation of cold weather kit.
103. Serve as linehandler to assist mooring to a ship at anchor.
104. Assist with craft fresh water wash.
105. Refill water wash tank with distilled water.
106. Assist loadmaster with rigging/unrigging stern ramp chains for AAV launch.
107. Assist with AAV launch.
108. Request and receive information from navigator regarding navigation issues.

LCAC Deck Mechanic Tasks
Importance

- 109. Perform raising and lowering of the ramps, as directed.
- 110. Assist with CRRC launch and recovery.
- 111. Assist crew personnel with maintenance of logs and preparation of reports.
- 112. Inspect port passenger compartment.
- 113. Perform inventory of reference publications maintained onboard.

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13. ABSTRACT (Maximum 200 words) Initially, the Naval Sea Systems Command (NAVSEA) provided Landing Craft Air Cushion (LCAC) crews with medical requirements for both selection and operational use in the "Safe Engineering and Operations (SEAOPS) Manual for Training Standardization and Evaluation of Crewmember Qualification, Landing Craft Air Cushion (LCAC)." However, the medical requirements were vague and could be loosely interpreted by medical authorities screening personnel for LCAC crew candidacy. Factors that led to the need for developing permanent LCAC medical selection standards included: 1) a constricted personnel pipeline for LCAC operators and lack of ready replacements; 2) the high cost of training; 3) a training fatality with medical implications; and 4) the evolving realization of LCAC uniqueness and special physical requirements needed for its successful operation. Naval Health Research Center in San Diego was tasked by NAVSEA (PMS377) to organize and coordinate the development of permanent medical selection standards for publication in the "Manual for the Medical Department (MANMED)," and to provide revised operational medical requirements for the SEAOPS manual. This report describes the steps taken to develop these standards, and a list of recommendations that should be considered in any future changes to the medical standards, to LCAC crew training/operational procedures, or to LCAC design.				
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